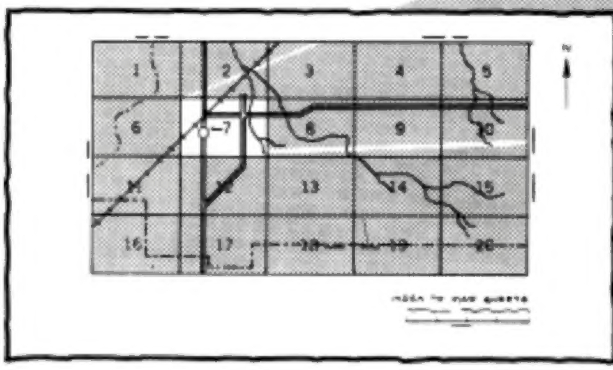
Soil survey of

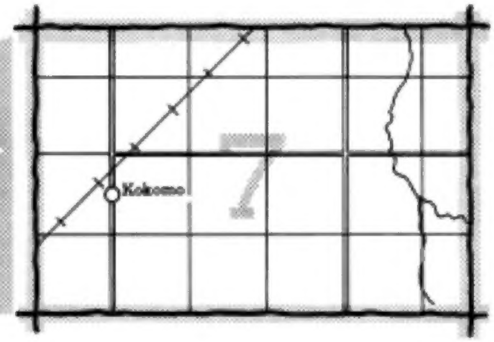
McPherson County SOUTH DAKOTA

United States Department of Agriculture
Soil Conservation Service
In cooperation with
South Dakota Agricultural Experiment Station

HOW TO USE

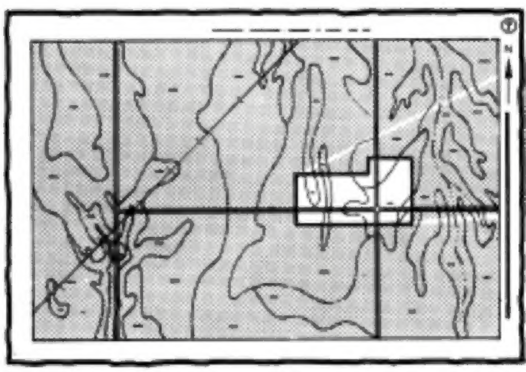
1. Locate your area of interest on the "Index to Map Sheets"

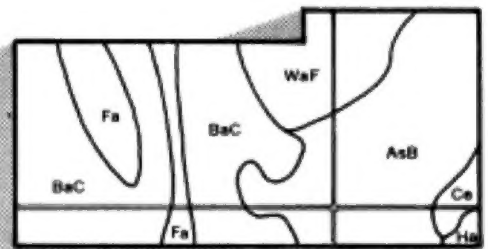




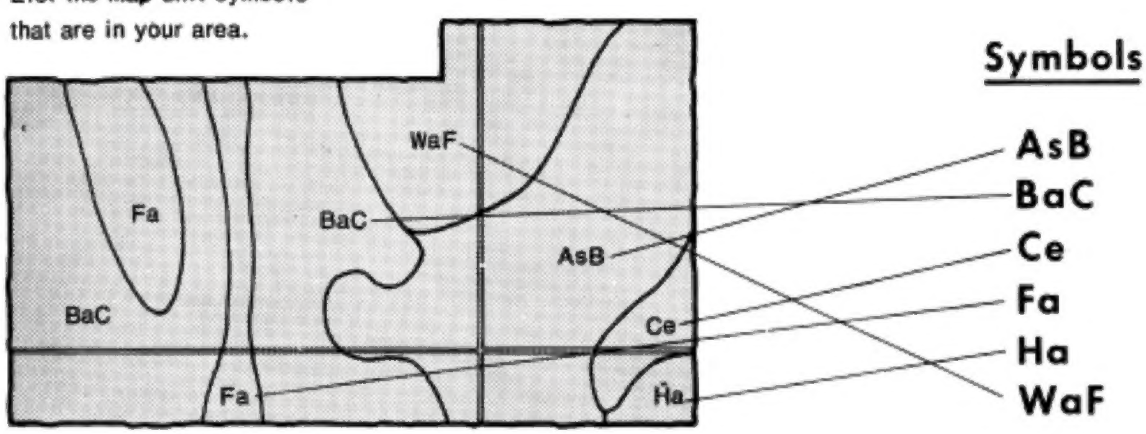
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



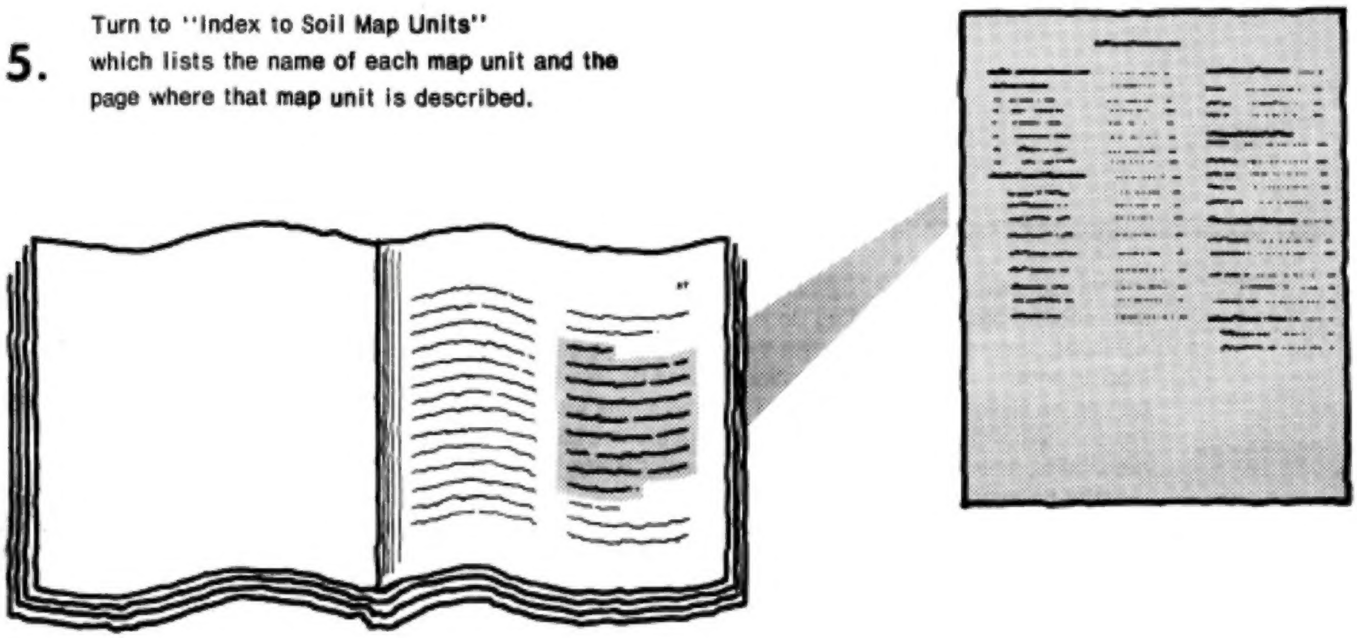


4. List the map unit symbols that are in your area.

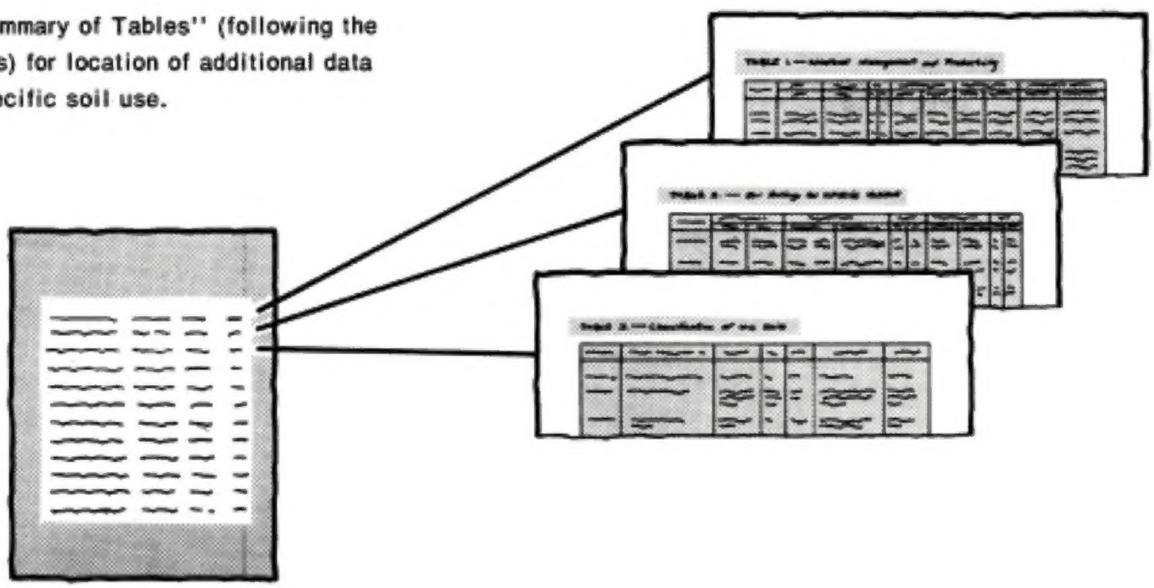


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the South Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the McPherson County Conservation District. Financial assistance was furnished by the South Dakota Department of Revenue, the McPherson County Commissioners, and the Old West Regional Commission. Some technicial assistance was provided by the Plant Science Department, South Dakota State University. Major fieldwork was performed in the period 1974 to 1979. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980.

Cover: Harvesting tame hay in an area of Williams-Bowbells loams, 1 to 6 percent slopes. The Williams soil is on the higher parts of the landscape, and the Bowbells soil is in the swales.

contents

soil series

Issued October 1981

index to map units

summary of tables

foreword

This soil survey contains information that can be used in land-planning programs in McPherson County, South Dakota. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

R. D. Swenson

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State Conservationist
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soil survey of
McPherson County, South Dakota

By Loren D. Schultz, Soil Conservation Service

Soils surveyed by Loren D. Schultz, Robert R. Blank, James A. Clausen, Nilo G. Reber, and Richard L. Schlepp, Soil Conservation Service, Thomas J. Martin, South Dakota State University, and David M. Bowes, South Dakota Division of Conservation

United States Department of Agriculture, Soil Conservation Service, in cooperation with the South Dakota Agricultural Experiment Station

MCPHERSON COUNTY is in the north-central part of South Dakota (fig. 1). It has a total area of 736,640 acres, which includes about 2,624 acres of water. Leola is the county seat. Other towns and communities are Eureka, Greenway, Hillsview, Long Lake, and Wetonka.

About half of the acreage in the county is cropland, and half supports native grass (*3*). Alfalfa, spring wheat, oats, and flax are the main crops. Barley, corn for silage, rye, and sunflowers also are important. Growing cash crops and hay, raising beef cattle, and dairying are the main farm enterprises.

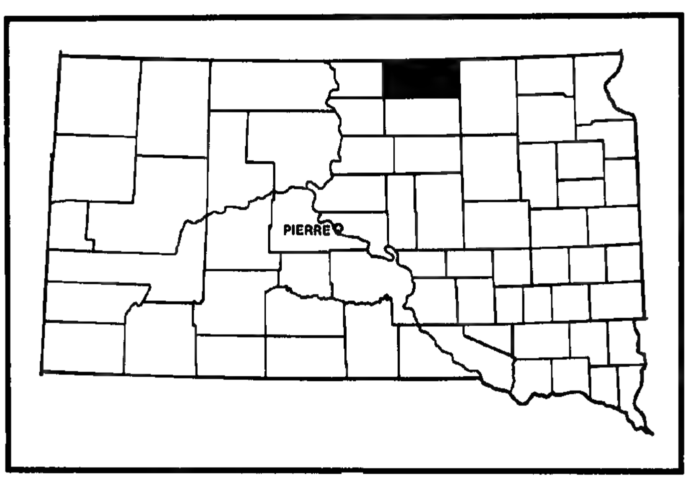


Figure 1.—Location of McPherson County in South Dakota.

general nature of the county

This section gives general information concerning the county. It describes climate; physiography, relief, and drainage; settlement; farming; and natural resources.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

McPherson County is usually warm in summer, but hot spells are frequent and cool days occasional. The county is very cold in winter, when arctic air frequently surges over the area. Most of the precipitation falls during the warm period, especially late in spring and early in summer. Snowfall is normally not heavy, and it is blown into drifts, so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Leola, South Dakota, in the period 1959 to 1977. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 14 degrees F, and the average daily minimum temperature is 3 degrees. The lowest temperature on record, which occurred at Leola on December 31, 1967, is -35 degrees. In summer the average temperature is 69 degrees, and the average daily maximum temperature is 84 degrees. The highest recorded temperature, which occurred at Leola on July 10, 1966, is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing

degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 19 inches. Of this, 15 inches, or 80 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 12 inches. The heaviest 1-day rainfall during the period of record was 3.75 inches at Leola on June 18, 1964. Thunderstorms occur on about 36 days each year, and most occur in summer. Hail falls at times in scattered small areas.

The average seasonal snowfall is about 35 inches. The greatest snow depth at any one time during the period of record was 16 inches. On an average of 26 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year. Blizzards occur several times each winter.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

physiography, relief, and drainage

The central and western parts of McPherson County are on the Missouri Coteau. The relief dominantly is undulating to hilly. Many potholes or closed depressions are in these parts of the county, and the drainage pattern is poorly defined. Spring Creek is the main drainageway. It flows westward to the Oahe Reservoir.

The eastern part of the county is on the Drift Prairie part of the James River Lowland (*7*). Relief dominantly is nearly level to undulating. The drainage pattern is well defined. The two principal drainageways are Foot and Snake Creeks. They flow southeast to the James River.

Land elevation ranges from 1,400 feet above sea level in the southeastern part of the county to about 2,100 feet in the north-central part.

settlement

McPherson County is named after James B. McPherson, a Civil War general. It was established by the Territorial Legislature in 1873. The original county included land now in North Dakota and excluded a small area along the eastern border now within the county. The present boundaries were established in 1885. The first permanent settlers arrived in 1882 (*10*). In March 1884, Leola was made the county seat. The population of the county was 5,940 by 1890 and peaked at 8,774 in 1930. It declined to 5,022 by 1970. Eureka has a population of 1,547, Leola has one of 787, Long Lake has one of 128, and Wetonka has one of 31.

Railroads have served the county since the early 1880's. South Dakota Highways 10, 45, and 47 and County Highway 247 are the main highways. Most rural areas are served by all-weather roads, which carry traffic to centers of trade.

farming

Farming is the principal enterprise in McPherson County. About 66 percent of the farm income is derived from the sale of livestock and livestock products (*11*). The first settlers grew mostly wheat. Eventually, fertility was reduced and wind and water erosion were prevalent. The McPherson County Conservation District was organized in 1954 to alleviate this situation (*9*). Grass was seeded on eroding cropland, and trees were planted to provide protection for farmsteads and to help control wind erosion.

In 1975, there were 670 farms in McPherson County. The average size farm is 1,090 acres. The trend is toward fewer and larger farms.

According to the South Dakota Crop and Livestock Reporting Service, about 83,000 acres was planted to spring wheat in 1977, 83,000 acres to alfalfa hay, 46,900 acres to oats, 20,300 acres to flax, 16,100 acres to barley, and 29,300 acres to corn. The corn from 22,000 of these acres was harvested for silage. The rest was harvested for grain. Rye, sorghum, and sunflowers are also grown.

natural resources

Soil is the most important natural resource in McPherson County. It provides a growing medium for crops and for the grass grazed by livestock. Other natural resources are ground water, wildlife, and sand and gravel.

The principal source of water for domestic use and for livestock is shallow wells. Deep wells, drilled to a depth of 1,600 to 2,000 feet, also provide a source of water (*8*). Water quantity generally is greater in the deep wells, but the quality is poor because of a high content of soluble salts. Dugouts in areas of Heil, Nishon, Parnell, and Tonka soils provide additional water for livestock and wildlife. Crompton, Elm, Eureka, Leola, and Wolff Lakes provide opportunities for fishing, boating, and waterfowl hunting. The drainageways flow only intermittently and provide water only during periods of snowmelt and high rainfall. In some areas shallow ground water of good quality is available in sufficient volume for irrigation.

Sand and gravel are deposited in scattered areas throughout the county. These deposits range from a few inches to more than 50 feet in thickness (*4*). They consist mainly of fine to coarse sand and some gravel,

silt, and clay. Because of an excessive amount of fine rock fragments, such as shale, chalk, and clay ironstone, the sand and gravel are unsuitable as concrete aggregate or as construction material. They are suitable, however, as subgrade material for roads and as bituminous aggregate.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied to a depth of 5 feet and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The associations on the general soil map of this county are described on the pages that follow. Because of differences in the detail of the general soil maps, their names do not coincide exactly with those on the general soil maps in the published surveys of adjacent Campbell, Edmunds, and Walworth Counties.

soil descriptions

1. Williams-Vida association

Well drained, undulating to hilly, loamy soils on uplands

This association is on a glacial till plain characterized by ridges and knolls interrupted by narrow swales that terminate in deep depressions. Slopes generally are short. They are mainly undulating to hilly. The drainage pattern is poorly defined. Stones and boulders are on some of the ridges and knolls.

This association makes up about 30 percent of the county. It is about 35 percent Williams soils, 30 percent Vida soils, and 35 percent minor soils.

The Williams soils are on the mid and lower parts of the landscape. In this association they have a slope of 3 to 15 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is dark grayish brown, brown, and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light brownish gray, calcareous clay loam.

The Vida soils are on the higher parts of the landscape. Slopes range from 3 to 25 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is dark grayish brown and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light brownish gray, calcareous clay loam.

The most extensive minor soils in this association are the moderately well drained Bowbells soils in swales and the very poorly drained Parnell soils in depressions. Less extensive are the silty Bryant soils on formerly ice-walled lake plains; the poorly drained Nishon and Tonka soils in shallow depressions; the excessively drained Wabek soils, which are on convex ridges and are underlain by gravelly sand; and the well drained, calcareous Zahill and Zahl soils on the upper parts of the steeper slopes and on convex ridgetops.

About 70 percent of this association is range. The less sloping areas are used for small grain and alfalfa. Controlling erosion and runoff is the main concern of management.

This association is well suited to range. It is poorly suited to cultivated crops because of the slope, the hazard of erosion, the many potholes and sloughs, and the scattered stones and boulders on the surface in some areas. It is well suited to rangeland wildlife habitat. The Williams and Vida soils are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential and the slope. They are poorly suited to septic tank absorption fields because of restricted permeability and slope.

2. Williams-Bowbells association

Well drained and moderately well drained, nearly level to gently rolling, loamy soils on uplands and in swales on uplands

This association is on a glacial till plain characterized by rises interrupted by narrow swales and many depressions. Slopes generally are short. They are mainly undulating but in some areas are nearly level and in others are gently rolling. The drainage pattern is poorly defined in most areas.

This association makes up about 29 percent of the county. It is about 50 percent Williams soils, 20 percent Bowbells soils, and 30 percent minor soils (fig. 2).

The well drained Williams soils are on rises. In this association they generally have a slope of 0 to 9 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is dark grayish brown, brown, and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light brownish gray, calcareous clay loam.

The moderately well drained and well drained Bowbells soils are in swales. Slopes range from 0 to 6 percent. Typically, the surface layer is dark gray loam. The subsoil is dark grayish brown and grayish brown clay loam. The underlying material is light brownish gray, calcareous clay loam.

Minor in this association are Bearpaw, Bryant, Grassna, Hamerly, Lehr, Niobell, Nishon, Parnell, Tonka, and Vida soils. The well drained Bearpaw and Bryant soils mainly are on the higher parts in the landscape. The moderately well drained Grassna soils are in swales adjacent to the Bryant soils. The somewhat poorly drained Hamerly soils are adjacent to depressions. The Niobell soils, which have a sodium affected subsoil, are in swales and on flats. The poorly drained Nishon and Tonka and very poorly drained Parnell soils are in depressions. The Lehr soils are underlain by gravelly sand. The Vida soils are on the steeper side slopes. They are only 8 to 24 inches deep over the underlying material.

About 65 percent of this association is cropland. Small grain, alfalfa, and corn are the main crops. Controlling erosion and conserving moisture are the main concerns of management.

This association is well suited to cultivated crops, tame pasture and hay, range, and openland wildlife habitat. The Williams soils are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential. They are poorly suited to septic tank absorption fields because of restricted permeability. The Bowbells soils generally are unsuited to building site development and septic tank absorption fields because they are subject to flooding.

3. Niobell-Noonan-Miranda association

Moderately well drained and somewhat poorly drained, nearly level and gently sloping, sodium affected, loamy soils on uplands

This association is on a glacial till plain, mainly on flats and rises interrupted by a few swales and many shallow depressions. The relief dominantly is nearly level to gently sloping but is steeper along the larger drainageways. The drainage system is poorly defined. Some small drainageways terminate in depressions.

This association makes up about 18 percent of the county. It is about 35 percent Niobell soils, 20 percent Noonan soils, 15 percent Miranda soils, and 30 percent minor soils (fig. 3).

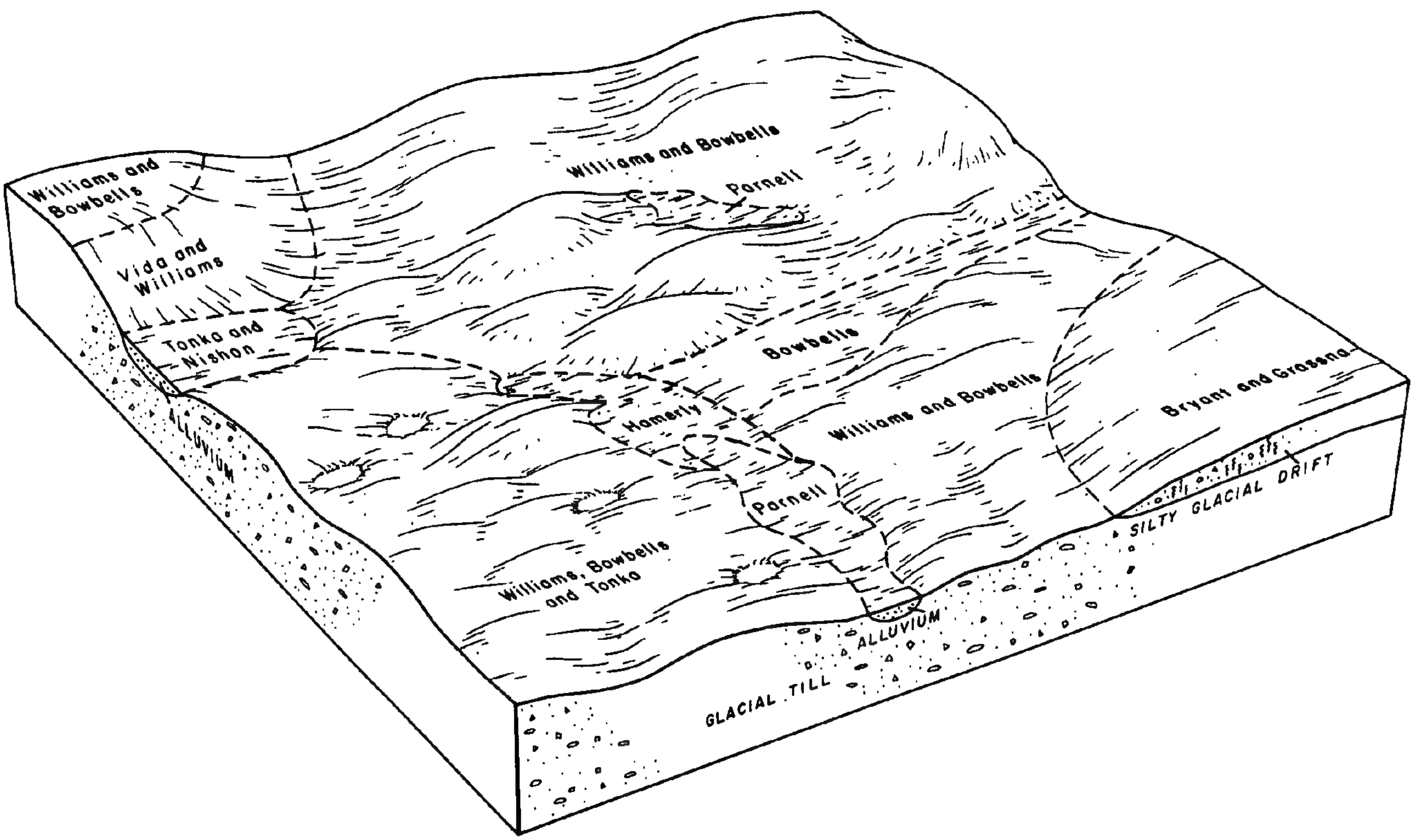


Figure 2.—Pattern of soils and parent material in the Williams-Bowbells association.

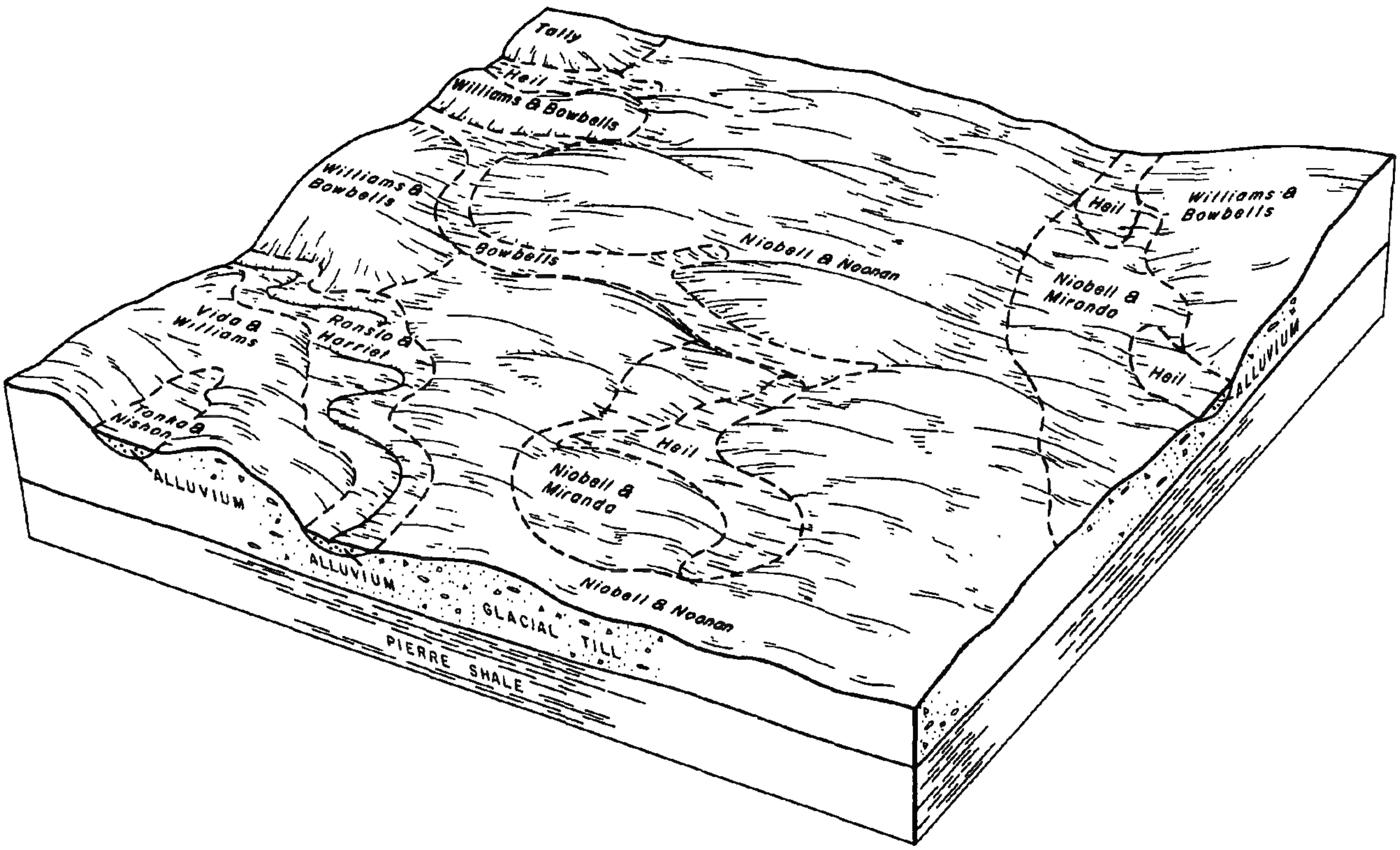


Figure 3.—Pattern of soils and parent material in the Niobell-Noonan-Miranda association.

The moderately well drained Niobell soils are on flats and slight rises. Slopes range from 0 to 5 percent. Typically, the surface layer is dark grayish brown and grayish brown loam. The subsoil is grayish brown, pale brown, and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light brownish gray and light yellowish brown, calcareous clay loam.

The moderately well drained Noonan soils are in concave areas or on flats adjacent to the Niobell and Miranda soils. Slopes range from 1 to 5 percent. Typically, the surface layer is dark grayish brown and grayish brown loam. The subsoil is brown and grayish brown, dense clay loam. In the lower part it contains gypsum and other salts that extend into the underlying material. The underlying material is light brownish gray, calcareous clay loam.

The somewhat poorly drained and moderately well drained Miranda soils are in microdepressions. In this association they have a slope of 0 to 2 percent. Typically, they have a thin surface layer of grayish brown loam. The subsoil is dark grayish brown and grayish brown, dense clay loam. It has nests of gypsum in the lower part. The underlying material is light yellowish brown, calcareous clay loam that has accumulations of carbonates and salts.

The dominant minor soils in this association are the somewhat poorly drained Ranslo and poorly drained Harriet soils on flood plains. Less extensive are the moderately well drained Bowbells soils in swales; the well drained Brantford soils, which are underlain by gravelly sand containing shale fragments; the poorly drained Heil, Nishon, and Tonka soils in shallow depressions; and the well drained Tally, Vida, and Williams soils on the higher parts of the landscape. The Bowbells, Brantford, Tally, Tonka, Vida, and Williams soils do not have a sodium affected subsoil.

About 70 percent of this association is cropland, most of which is used for tame pasture or hay. Small grain is grown in a few areas. Measures that increase the water intake rate, conserve moisture, and improve tilth are the main management needs if the major soils are used for cultivated crops.

This association generally is poorly suited to cultivated crops and to openland wildlife habitat. It is fairly well suited to tame pasture and hay; range, and rangeland wildlife habitat. All of the major soils are poorly suited to most kinds of building site development because of a

moderate or high shrink-swell potential. They are poorly suited to septic tank absorption fields because of restricted permeability.

4. Lehr-Bowdle-Wabek association

Excessively drained to well drained, nearly level to hilly, loamy soils on outwash plains, terraces, and uplands

This association is on glacial outwash plains, stream terraces, and uplands that are characterized by depressions and perennial lakes. Slopes generally are short but are long and smooth along drainageways. Stones are on some ridges.

This association makes up about 14 percent of the county. It is about 35 percent Lehr soils, 30 percent Bowdle soils, 25 percent Wabek soils, and 10 percent minor soils.

The somewhat excessively drained Lehr soils are on the mid and higher parts of the landscape. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is brown loam. The underlying material is multicolored, calcareous gravelly sand.

The well drained Bowdle soils are in smooth areas and in swales. Slopes range from 0 to 6 percent. Typically, the surface layer and subsoil are dark grayish brown loam. The underlying material is multicolored, calcareous gravelly sandy loam and gravelly sand.

The excessively drained Wabek soils are on ridges and knolls. Slopes range from 2 to 20 percent. Typically, the surface layer is dark grayish brown gravelly loam. The underlying material is dark grayish brown, calcareous gravelly sandy loam over multicolored, calcareous gravelly sand.

Minor in this association are Divide, Lihen, Marysland, and Regan soils. The somewhat poorly drained, calcareous Divide soils are in shallow depressions and beach areas around lakes. The sandy Lihen soils are on ridges and side slopes adjacent to the glacial till plains. The poorly drained, calcareous Marysland soils are in depressions and beach areas. The very poorly drained, calcareous Regan soils are in depressions and on flood plains.

About 60 percent of this association is cropland. Small grain and alfalfa are the main crops. Some of the steeper areas support native grass and are used for grazing or hay. Measures that conserve moisture, control erosion, and improve fertility are the main management needs.

This association is fairly well suited to range and to rangeland wildlife habitat. The Lehr soils are fairly well suited to tame pasture and hay and poorly suited to cultivated crops. The Bowdle soils are well suited to tame pasture and hay and fairly well suited to cultivated crops. The Wabek soils are poorly suited to tame pasture and hay and generally unsuited to cultivated crops. All of the major soils are well suited to most kinds of building site development. They are poorly suited to most sanitary facilities, however, because the effluent can seep through the gravelly underlying material and pollute shallow ground water.

5. Bearpaw-Greenway association

Well drained, nearly level to moderately sloping, loamy soils on uplands

This association is on glacial till plains where nearly level areas are interrupted by slight rises. The soils are moderately sloping along drainageways.

This association makes up about 3 percent of the county. It is about 60 percent Bearpaw soils, 30 percent Greenway soils, and 10 percent minor soils.

The Bearpaw soils are on smooth slopes, on the tops of rises, and on slopes adjacent to drainageways. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is dark grayish brown, grayish brown, and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light brownish gray, calcareous clay loam.

The Greenway soils are on mid slopes and the tops of slight rises. Slopes range from 0 to 6 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is dark grayish brown, light brownish gray, light olive brown, and grayish brown clay loam, loam, and sandy loam. The underlying material is light brownish gray and grayish brown, calcareous clay loam.

Minor in this association are Bryant, Grail, Grassna, Temvik, and Vida soils. The Bryant soils are on the middle parts of side slopes where the silt mantle is more than 40 inches thick. The moderately well drained Grail and Grassna soils are in swales and on toe slopes adjacent to drainageways. The Temvik soils formed in a silty mantle over glacial till. They are on the upper and mid side slopes along drainageways. The Vida soils are on the steeper side slopes. They are only 8 to 24 inches deep over the underlying material.

About 70 percent of this association is cropland. Small grain and alfalfa are the main crops. Some of the steeper areas along drainageways support native grass and are used for grazing. Measures that control erosion, conserve moisture, and improve tilth are the main management needs.

The Greenway soils are well suited to cultivated crops, tame pasture and hay, range, and openland wildlife habitat. The Bearpaw soils are only fairly well suited to cultivated crops and to openland wildlife habitat, but they are well suited to tame pasture and hay and to range. Both of the soils are poorly suited to most kinds of building site development because of a high shrink-swell potential. They are poorly suited to septic tank absorption fields because of restricted permeability.

6. Vida association

Well drained, undulating to moderately steep, loamy soils on uplands

This association is on glacial moraines characterized by stony ridges and knolls interrupted by narrow swales.

The swales terminate in deeply entrenched depressions. Slopes generally are short. The drainage generally is poorly defined.

This association makes up about 3 percent of the county. It is about 65 percent Vida soils and 35 percent minor soils.

Typically, the surface layer of the Vida soils is dark grayish brown loam. The subsoil is dark grayish brown and light brownish gray, friable clay loam. It is calcareous in the lower part. The underlying material is light brownish gray, calcareous clay loam. Slopes range from 3 to 25 percent.

Minor in this association are Bowbells, Parnell, Wabek, Zahill, and Zahl soils. The moderately well drained Bowbells soils are in swales. The very poorly drained Parnell soils are in depressions. The excessively drained Wabek soils are on convex ridges. They are underlain by gravelly sand. The well drained Zahill and Zahl soils are calcareous within a few inches of the surface. They are on the upper parts of the steeper slopes and on convex ridgetops.

About 90 percent of this association is range. In most areas the soils are too steep or too stony to be cultivated. Some of the less sloping areas are used for cultivated crops, mainly forage crops. Measures that control erosion are the main management needs.

This association is well suited to range and to rangeland wildlife habitat. It is poorly suited to cultivated crops and to tame pasture and hay because of the slope and the numerous stones in many areas. The Vida soils are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential and the slope. They are poorly suited to septic tank absorption fields because of restricted permeability and slope.

7. Bryant-Grassna association

Well drained and moderately well drained, nearly level to moderately sloping, silty soils on uplands and in swales on uplands

This association is on glacial drift plains characterized by long, smooth slopes, wide swales, and a few scattered depressions. The drainage pattern is poorly defined.

This association makes up about 2 percent of the county. It is about 45 percent Bryant soils, 35 percent Grassna soils, and 20 percent minor soils.

The well drained Bryant soils are on the higher parts of the landscape. Slopes range from 0 to 9 percent. Typically, the surface layer is dark grayish brown silt loam. It is calcareous in the lower part. The subsoil is grayish brown and light brownish gray silt loam. The underlying material is light brownish gray, calcareous silt loam and loam.

The moderately well drained Grassna soils are in swales and on toe slopes. Slopes range from 0 to 3 percent. Typically, the surface layer is dark gray silt loam. The subsoil is dark grayish brown silt loam. The underlying material is light gray, calcareous silt loam.

Minor in this association are Grail, Lihen, Mondamin, Nishon, Tally, Tansem, Tonka, and Williams soils. The moderately well drained Grail soils are in swales. Their subsoil contains more clay than that of the major soils. The sandy Lihen and loamy Tally soils are on ridges and the upper side slopes. The Mondamin soils are on the higher parts of the landscape. Their subsoil contains more clay than that of the major soils. The poorly drained Nishon and Tonka soils are in shallow depressions. The loamy Tansem soils are on formerly ice-walled lake plains. The loamy Williams soils are adjacent to the glacial till plains.

About 90 percent of this association is cropland. Small grain and alfalfa are the main crops. Measures that control erosion and conserve moisture are the main management needs.

This association is well suited to cultivated crops, tame pasture and hay, range, and openland wildlife habitat. The Bryant soils are well suited to most kinds of building site development and to septic tank absorption fields. The Grassna soils generally are unsuited to building site development and septic tank absorption fields because they are subject to flooding.

8. Harmony-Arnegard association

Moderately well drained and well drained, nearly level, silty and loamy soils on lake plains

This association is on glacial lake plains. It is characterized by flat areas and slight rises interrupted by a few drainage channels.

This association makes up about 1 percent of the county. It is about 35 percent Harmony soils, 25 percent Arnegard soils, and 40 percent minor soils.

The moderately well drained Harmony soils are on smooth slopes and in slight swales. Slopes are 0 to 2 percent. Typically, the surface layer is dark gray silty clay loam. The subsoil is dark gray silty clay over grayish brown silty clay loam. The underlying material is light brownish gray, calcareous silty clay loam.

The well drained Arnegard soils are on flats and slight rises. Slopes are long and smooth and are 0 to 2 percent. Typically, the surface layer is dark gray loam. The subsoil is dark gray, dark grayish brown, and light brownish gray loam. It is calcareous in the lower part. The underlying material is light brownish gray, calcareous loam and fine sandy loam.

The most extensive minor soils in this association are the Rentill soils, which are calcareous near the surface and are on smooth and slightly convex slopes. Less extensive are the somewhat poorly drained Bearden and poorly drained Regan soils in the lower concave areas; the somewhat poorly drained Divide and moderately well drained Straw soils along drainage channels; and the

Exline soils, which have a dense, sodium affected subsoil and are in microdepressions.

About 90 percent of this association is cropland. Corn, small grain, and alfalfa are the main crops. Runoff ponds for short periods in the microdepressions. Measures that increase the water intake rate, conserve moisture during dry periods, and improve tilth are the main management needs.

This association is well suited to cultivated crops, tame pasture and hay, range, and openland wildlife habitat. The Harmony soils are poorly suited to most kinds of building site development because of a high shrink-swell potential. They are poorly suited to septic tank absorption fields because of restricted permeability. The Arnegard soils are well suited to most kinds of building site development and to septic tank absorption fields.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and identifies the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bearpaw loam, 0 to 3 percent slopes, is one of several phases in the Bearpaw series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Williams-Bowbells-Tonka complex, 0 to 3 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

The names of some map units on the detailed soil maps do not fully agree with those in the published surveys of Campbell, Edmunds, and Walworth Counties. Differences are the result of variations in the design and composition of map units or changes in the application of the soil classification system.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

3A—Bowdle loam, 0 to 3 percent slopes. This well drained, nearly level and very gently sloping soil is on terraces and uplands. It is moderately deep over gravelly sand. Areas are irregular in shape and are 5 to 275 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is dark grayish brown, friable loam about 15 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sandy loam and gravelly sand. In places the soil is dark to a depth of less than 16 inches.

Included with this soil in mapping are small areas of Divide and Lehr soils. These soils make up less than 15 percent of any one mapped area. Divide soils have lime in the surface layer. They are on the lower parts of the landscape. Lehr soils are underlain by gravelly sand at a depth of 14 to 20 inches. They are higher on the landscape than the Bowdle soil.

The content of organic matter and fertility are high in the Bowdle soil. Because of the porous underlying material, root penetration is restricted and the soil is somewhat droughty. Available water capacity is low or moderate. Permeability is moderate in the subsoil and rapid in the underlying gravelly sand. Runoff is slow.

Most of the acreage is cropland. This soil is fairly well suited to cultivated crops and to tame pasture and hay. Because it is somewhat droughty, it is better suited to

early maturing small grain than to row crops. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface. Only those grasses that are drought resistant are suitable. Crested wheatgrass and pubescent wheatgrass are examples. The soil is well suited to irrigation.

This soil is poorly suited to windbreaks and environmental plantings. No trees or shrubs grow well. Windbreaks and environmental plantings can be established, but optimum growth, survival, and vigor are unlikely.

This soil is well suited to range. The native vegetation dominantly is green needlegrass, western wheatgrass, and needleandthread. Overused areas are dominated by western wheatgrass, needleandthread, and blue grama.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soil is a probable source of sand and gravel for road construction.

The capability subclass is IIIs; Silty range site.

3B—Bowdle loam, 3 to 6 percent slopes. This well drained, gently sloping soil is on terraces and uplands. It is moderately deep over gravelly sand. Areas are irregular in shape and are 5 to 30 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is dark grayish brown, friable loam about 15 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sandy loam and gravelly sand. In places the soil is dark to a depth of less than 16 inches.

Included with this soil in mapping are small areas of Divide and Lehr soils. These soils make up less than 15 percent of any one mapped area. Divide soils have lime in the surface layer. They are on the lower parts of the landscape. Lehr soils are underlain by gravelly sand at a depth of 14 to 20 inches. They are higher on the landscape than the Bowdle soil.

The content of organic matter and fertility are high in the Bowdle soil. Because of the porous underlying material, root penetration is restricted and the soil is somewhat droughty. Available water capacity is low or moderate. Permeability is moderate in the subsoil and rapid in the underlying gravelly sand. Runoff is slow.

Most of the acreage is cropland. This soil is fairly well suited to cultivated crops and to tame pasture and hay. Because it is somewhat droughty, it is better suited to early maturing small grain than to row crops. Measures that control erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface. Only those grasses that are drought resistant are suitable. Crested wheatgrass and pubescent wheatgrass are examples. The soil is well suited to irrigation.

This soil is poorly suited to windbreaks and environmental plantings. No trees or shrubs grow well. Windbreaks and environmental plantings can be established, but optimum growth, survival, and vigor are unlikely.

This soil is well suited to range. The native vegetation dominantly is green needlegrass, western wheatgrass, and needleandthread. Overused areas are dominated by western wheatgrass, needleandthread, and blue grama.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soil is a probable source of sand and gravel for road construction.

The capability subclass is IIe; Silty range site.

5A—Bowbells loam, 0 to 2 percent slopes. This deep, moderately well drained, nearly level soil is in swales on uplands. It is occasionally flooded for very brief periods. Areas generally are long and narrow and are 10 to 100 acres in size. Slopes are smooth and slightly concave.

Typically, the surface layer is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with this soil in mapping are small areas of Cresbard, Tonka, and Williams soils. These soils make up less than 15 percent of any one mapped area. Cresbard soils have a sodium affected subsoil. They are on the lower parts of the landscape. The poorly drained Tonka soils are in depressions. The well drained Williams soils are on the higher parts of the landscape.

The content of organic matter and fertility are high in the Bowbells soil. Permeability is moderate in the subsoil and moderately slow in the underlying material. Available water capacity is high. A seasonal water table is at a depth of 4 to 6 feet. Runoff is slow. The shrink-swell potential is moderate in the subsoil and underlying material.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well. Measures that conserve moisture during dry periods are the main management needs. Examples are tillage practices that leave crop residue on the surface. Fieldwork is delayed in some years because of the wetness caused by runoff from the adjacent uplands.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil is well suited to range. The native vegetation dominantly is big bluestem and lesser amounts of western wheatgrass and green needlegrass. Overused areas are dominated by western wheatgrass and Kentucky bluegrass.

This soil generally is unsuitable as a site for buildings and most sanitary facilities because of the flooding.

The capability subclass is IIc; Overflow range site.

5B—Bowbells loam, 2 to 6 percent slopes. This deep, well drained and moderately well drained, gently sloping soil is in broad swales on uplands. Areas are long and narrow or irregular in shape and are 5 to 50 acres in size. Slopes are smooth or slightly concave.

Typically, the surface layer is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with this soil in mapping are small areas of Grail, Tonka, and Williams soils. These soils make up less than 15 percent of any one mapped area. Grail soils contain more clay than the Bowbells soil. Also, they are lower on the landscape. The poorly drained Tonka soils are in depressions. The well drained Williams soils are on the higher parts of the landscape.

The content of organic matter and fertility are high in the Bowbells soil. Permeability is moderate in the subsoil and moderately slow in the underlying material. Available water capacity is high. Runoff is slow. The shrink-swell potential is moderate in the subsoil and underlying material.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well. Measures that control erosion and conserve moisture during dry periods are the main management needs. Examples are tillage practices that leave crop residue on the surface. Fieldwork is delayed in some years because of wetness in the lower lying areas.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil is well suited to range. The natural vegetation dominantly is western wheatgrass and needlegrasses. Overused areas are dominated by western wheatgrass and Kentucky bluegrass.

This soil is fairly well suited to building site development. The shrink-swell potential is the main limitation. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The capability subclass is IIe; Silty range site.

6—Arnegard loam. This deep, well drained, nearly level soil is on glacial lake plains. Areas are irregular in shape and 5 to 350 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark gray loam about 9 inches thick. The subsoil is dark gray, dark grayish brown, and light brownish gray, friable loam about 13 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous loam and fine sandy loam. In places the subsoil contains more silt.

Included with this soil in mapping are small areas of Bearden, Harmony, Lehr, and Rentill soils. These soils make up less than l5 percent of any one mapped area. Bearden and Harmony soils are on the slightly lower parts of the landscape. Bearden soils are somewhat poorly drained, and Harmony soils contain more clay in the subsoil than the Arnegard soil. Lehr soils have gravelly sand within a depth of 20 inches. They are on the higher convex parts of the landscape. Rentill soils contain more sand in the upper part and more clay in the lower part than the Arnegard soil. Their position on the landscape is similar to that of the Arnegard soil.

The content of organic matter and fertility are high in the Arnegard soil. Permeability is moderate. Available water capacity is high. Runoff is slow.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable. The soil is well suited to irrigation.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil is well suited to range. The natural plant cover dominantly is bluestems, western wheatgrass, and green needlegrass. Overused areas are dominated by western wheatgrass, needleandthread, and blue grama.

This soil is well suited to most kinds of building site development and most sanitary facilities.

The capability subclass is IIc; Silty range site.

7—Bearden silt loam. This deep, somewhat poorly drained, nearly level soil is in swales and flat basinlike areas. Areas are irregular in shape and are 5 to 65 acres in size. Slopes are smooth and slightly concave.

Typically, the surface layer is very dark gray, calcareous silt loam about 12 inches thick. The next 3 inches is gray, calcareous silt loam. The underlying material to a depth of 60 inches is light brownish gray and grayish brown, calcareous silt loam. It has accumulations of carbonate below a depth of 33 inches.

In places the accumulations of carbonate are below a depth of 16 inches.

Included with this soil in mapping are small areas of Arnegard and Regan soils. These soils make up less than 15 percent of any one mapped area. The Arnegard soils contain more sand between depths of 10 and 40 inches than the Bearden soil. They are on the slightly higher parts of the landscape. The poorly drained Regan soils are on the lower parts of the landscape. Also included are saline spots as much as 3 acres in size.

The content of organic matter is moderate and fertility medium in the Bearden soil. Permeability is moderately slow. Available water capacity is high. The water table is at a depth of 1.5 to 2.5 feet early in spring and during other wet periods. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well. The main management needs are measures that control wind erosion and improve fertility. The high content of lime in the surface layer adversely affects the availability of plant nutrients and increases the susceptibility to wind erosion. Tillage practices that leave crop residue on the surface help to control wind erosion, conserve moisture, and improve fertility. Stripcropping also helps to control wind erosion.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil is well suited to range. The natural plant cover dominantly is bluestems, needlegrasses, and western wheatgrass. Overused areas are dominated by western wheatgrass and Kentucky bluegrass.

This soil is poorly suited to building site development and generally unsuited to sanitary facilities because of the wetness.

The capability subclass is IIe; Limy Subirrigated range site.

8—Rentill loam. This deep, well drained, nearly level soil is on lake plains. Areas are irregular in shape and are 5 to 300 acres in size. Slopes are smooth and slightly convex.

Typically, the surface layer is dark gray, calcareous loam about l2 inches thick. The upper 19 inches of the underlying material is light brownish gray, calcareous fine sandy loam. The lower part to a depth of 60 inches is gray and dark gray, calcareous silty clay and clay loam.

Included with this soil in mapping are small areas of Arnegard, Bearden, Harmony, and Lehr soils. These soils make up less than 15 percent of any one mapped area. Arnegard soils contain less sand and less lime in the upper part than the Rentill soil. Their position on the landscape is similar to that of the Rentill soil. Bearden and Harmony soils are slightly lower on the landscape than the Rentill soil. Bearden soils are somewhat poorly drained, and Harmony soils contain more clay in the upper part than the Rentill soil. Lehr soils are underlain by gravelly sand at a depth of 14 to 20 inches. They are on the higher convex parts of the landscape.

The content of organic matter is moderate and fertility medium in the Rentill soil. Permeability is moderate or moderately rapid in the upper part of the soil and slow in the lower part. Available water capacity is moderate or high. Runoff is slow. The shrink-swell potential is high in the lower part of the underlying material.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, except for those that require an abundant supply of moisture.

This soil is well suited to range. The native vegetation dominantly is needlegrasses, western wheatgrass, and bluestems. Overused areas are dominated by western wheatgrass, blue grama, and Kentucky bluegrass.

Because of the high shrink-swell potential, this soil is poorly suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

This soil is poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The capability subclass is IIs; Silty range site.

9A—Bearpaw loam, 0 to 3 percent slopes. This deep, well drained, nearly level and very gently sloping soil is on uplands. Scattered stones are on the surface in some areas that support native grass. Areas are irregular in shape and 15 to 75 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray, firm clay loam about 15 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with this soil in mapping are small areas of Cavour, Grail, and Miranda soils. These soils make up less than 15 percent of any one mapped area. Cavour and Miranda soils have a sodium affected subsoil. Cavour soils are in smooth or slightly concave areas, and Miranda soils are in microdepressions. The moderately well drained Grail soils are in swales. They are dark to a depth of more than 16 inches.

The content of organic matter is moderate and fertility medium in the Bearpaw soil. Tilth is fair. Runoff is slow. Permeability is moderately slow in the subsoil and slow in the underlying material. Available water capacity is moderate or high. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well. Conserving moisture, improving tilth, and increasing the rate of water intake are the main concerns of management. Tilling when the soil is wet causes compaction of the subsoil. Tillage practices that leave crop residue on the surface conserve moisture and improve tilth. Chiseling and subsoiling increase the rate of water intake.

This soil is well suited to range. The native vegetation dominantly is western wheatgrass, needleandthread, and green needlegrass. Overused areas are dominated by western wheatgrass, Kentucky bluegrass, and other short grasses.

This soil is only fairly well suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs grow well. The soil takes in water slowly, however, and the clayey subsoil can restrict the penetration of tree roots.

This soil is poorly suited to building site development because of the high shrink-swell potential. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The capability subclass is IIs; Clayey range site.

9B—Bearpaw loam, 3 to 6 percent slopes. This deep, well drained, gently sloping soil is on uplands. Scattered stones are on the surface in some areas that support native grass. Areas are irregular in shape and are 5 to 160 acres in size. Slopes are smooth and convex.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray, firm clay loam about 15 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with this soil in mapping are small areas of Cavour, Grail, and Miranda soils. These soils make up less than 15 percent of any one mapped area. Cavour and Miranda soils have a sodium affected subsoil. Cavour soils are in smooth or slightly concave areas, and Miranda soils are in microdepressions. The moderately well drained Grail soils are in swales. They are dark to a depth of more than 16 inches.

The content of organic matter is moderate and fertility medium in the Bearpaw soil. Tilth is fair. Permeability is moderately slow in the subsoil and slow in the underlying material. Available water capacity is moderate or high. Runoff is medium. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is fairly well suited to cultivated crops. It is well suited to tame pasture and hay. Tilling when the soil is wet causes compaction of the subsoil. Measures that control erosion, conserve moisture, improve tilth, and increase the rate of water intake are the main management needs. Examples are tillage practices that leave crop residue on the surface.

This soil is well suited to range. The native vegetation is dominantly western wheatgrass, needleandthread, and green needlegrass. Overused areas are dominated by western wheatgrass, Kentucky bluegrass, and short grasses.

This soil is only fairly well suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs grow well. The soil takes in water slowly, however, and the clayey subsoil can restrict the penetration of tree roots.

This soil is poorly suited to building site development because of the high shrink-swell potential. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The capability subclass is IIIe; Clayey range site.

9C—Bearpaw loam, 6 to 9 percent slopes. This deep, well drained, moderately sloping soil is on uplands. Scattered stones are on the surface in most areas that support native grass. Areas are long and narrow or irregular in shape and are 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray, firm clay loam about 15 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places, the surface layer is thinner and carbonates are closer to the surface.

Included with this soil in mapping are small areas of Grail and Miranda soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Grail soils are in swales. They are dark to a depth of more than 16 inches. Miranda soils have a sodium affected subsoil. They are on the lower side slopes. Also included, on side slopes, are slickspots or seepy areas, which support no vegetation.

The content of organic matter is moderate and fertility medium in the Bearpaw soil. Permeability is moderately slow in the subsoil and slow in the underlying material. Available water capacity is moderate or high. Runoff is medium. The shrink-swell potential is high.

About half of the acreage is cropland. This soil is poorly suited to cultivated crops. Controlling erosion and improving tilth are the main concerns of management. Tilling when the soil is wet causes compaction of the subsoil. Tillage practices that leave crop residue on the surface help to control erosion, improve tilth, and increase the rate of water intake. Contour farming, grassed waterways, and terraces also help to control erosion, but some slopes are too short or irregular for contouring and terracing.

This soil is well suited to tame pasture and hay. A cover of tame pasture plants or hay is effective in controlling erosion. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable.

This soil is well suited to range. The native vegetation dominantly is western wheatgrass, needleandthread, and green needlegrass. Overused areas are dominated by western wheatgrass, bluegrass, and other short grasses.

This soil is only fairly well suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs grow well. The soil takes in water slowly, however, and the clayey subsoil can restrict the penetration of tree roots. Planting on the contour helps to control erosion.

Because of the slope and the high shrink-swell potential, this soil is poorly suited to building development. Buildings should be designed to conform to the natural slope of the land. Land shaping is needed in some areas. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the slope and the restricted permeability, this soil is poorly suited to sanitary facilities. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste. Land shaping and installing the distribution lines across the slope generally improve the efficiency of these fields.

The capability subclass is IVe; Clayey range site.

10—Brantford loam. This nearly level, well drained soil is on terraces. It is shallow to gravelly sand. Areas are irregular in shape and are 5 to 165 acres in size. Slopes are smooth and slightly convex.

Typically, the surface layer is dark gray loam about 7 inches thick. The subsoil is grayish brown, friable clay loam about 9 inches thick. The underlying material to a depth of 60 inches is dark grayish brown gravelly sand in which the content of shale fragments is, by volume, 35 to 50 percent.

Included with this soil in mapping are small areas of Harriet, Ranslo, and Tally soils. These soils make up less than 15 percent of any one mapped area. Harriet and Ranslo soils have a sodium affected subsoil. They are on flood plains. Tally soils contain less clay in the subsoil than the Brantford soil and do not have gravelly sand in the underlying material. They are on knolls.

The content of organic matter is moderate and fertility medium in the Brantford soil. Permeability is moderate in the subsoil and very rapid in the underlying gravelly sand. Available water capacity is low. Runoff is slow. The porous underlying material restricts the penetration of plant roots.

About half of the acreage is cropland. This soil is poorly suited to cultivated crops. Because it is shallow to gravelly sand, it is droughty. Small grain is the best suited crop because it matures early in the growing season. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface.

This soil is only fairly well suited to tame pasture and hay. The choice of pasture plants is limited by the low available water capacity and the shallow root zone. Crested wheatgrass is the best suited species.

This soil is fairly well suited to range. The native vegetation dominantly is needleandthread, western wheatgrass, and blue and hairy grama. Overused areas are dominated by threadleaf sedge, blue grama, and weeds.

This soil is poorly suited to windbreaks and environmental plantings. No trees or shrubs grow well. Optimum survival, growth, and vigor are unlikely.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soil is an improbable source of sand and gravel for use as road construction material because of the large amount of shale in the underlying material.

The capability subclass is IVs; Shallow to Gravel range site.

11A—Bearpaw-Greenway loams, 0 to 3 percent slopes. These deep, well drained, nearly level and gently undulating soils are on uplands. Scattered stones are on the surface in some areas that support native grass. Areas are irregular in shape and 40 to more than 1,500 acres in size. They are 45 to 55 percent Bearpaw soil and 30 to 40 percent Greenway soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Bearpaw soil is dark grayish brown loam about 5 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray, firm clay loam about 15 inches thick. In the lower part it has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Typically, the surface layer of the Greenway soil is dark grayish brown loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part is dark grayish brown, light brownish gray, and light olive brown, friable loam, clay loam, and sandy loam. The lower part is grayish brown and light brownish gray, firm clay loam. It is calcareous below a depth of about 24 inches. The underlying material to a depth of 60 inches is light brownish gray and grayish brown, calcareous clay loam.

Included with these soils in mapping are small areas of Grail, Grassna, and Tonka soils. These included soils make up less than 15 percent of any one mapped area. The moderately well drained Grail and Grassna soils are in swales and along drainageways. They are dark to a depth of more than 16 inches. The poorly drained Tonka soils are in depressions.

The content of organic matter is moderate and fertility medium in the Bearpaw and Greenway soils. Permeability is moderately slow in the subsoil of the Bearpaw soil and slow in the underlying material. It is moderate in the upper part of the Greenway soil and slow in the lower part. Available water capacity is moderate or high in the Bearpaw soil and high in the Greenway soil. Runoff is slow on both soils. The shrink-swell potential is high in the Bearpaw soil. It is moderate in the upper part of the Greenway soil and high in the lower part.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well. The main concerns of management are conserving moisture and improving tilth. Tilling the Bearpaw soil when it is wet causes compaction of the subsoil. Tillage practices that leave crop residue on the surface conserve moisture, increase the rate of water intake, and improve tilth.

These soils are suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well.

These soils are well suited to range. The native vegetation dominantly is western wheatgrass, needlegrasses, and blue grama. Overused areas are dominated by western wheatgrass. If overuse continues, blue grama and Kentucky bluegrass dominate the site.

Because of the shrink-swell potential, the Bearpaw soil is poorly suited and the Greenway soil only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, these soils are poorly suited to septic tank absorption fields. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The Bearpaw soil is in capability subclass IIs, Clayey range site; the Greenway soil is in capability subclass IIc, Silty range site.

11B—Bearpaw-Greenway loams, 3 to 6 percent slopes. These deep, well drained, gently sloping soils are on uplands. Scattered stones are on the surface in some areas that support native grass. Areas are irregular in shape and 20 to 300 acres in size. They are 40 to 50 percent Bearpaw soil and 30 to 40 percent Greenway soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Bearpaw soil is dark grayish brown loam about 5 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray, firm clay loam about 15 inches thick. In the lower part it has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Typically, the surface layer of the Greenway soil is dark grayish brown loam about 8 inches thick. The subsoil is about 25 inches thick. The upper part is dark grayish brown, light brownish gray, and light olive brown, friable loam, clay loam, and sandy loam. The lower part is grayish brown and light brownish gray, firm clay loam. It is calcareous below a depth of about 24 inches. The underlying material to a depth of 60 inches is light brownish gray and grayish brown, calcareous clay loam.

Included with these soils in mapping are small areas of Grail, Grassna, Tonka, and Vida soils. These included soils make up less than 20 percent of any one mapped area. The moderately well drained Grail and Grassna soils are in swales and along drainageways. They are dark to a depth of more than 16 inches. The poorly drained Tonka soils are in depressions. Vida soils have free carbonates within a depth of 10 inches. They are on the higher convex parts of the landscape.

The content of organic matter is moderate and fertility medium in the Bearpaw and Greenway soils. Permeability is moderately slow in the subsoil of the Bearpaw soil and slow in the underlying material. It is moderate in the upper part of the Greenway soil and slow in the lower part. Available water capacity is moderate or high in the Bearpaw soil and high in the Greenway soil. Runoff is medium on both soils. The shrink-swell potential is high in the Bearpaw soil. It is moderate in the upper part of the Greenway soil and high in the lower part.

Most of the acreage is cropland. The Greenway soil is well suited to cultivated crops, but the Bearpaw soil is only fairly well suited. Controlling erosion, improving the tilth of the Bearpaw soil, and conserving moisture are the main concerns of management. Tilling the Bearpaw soil when it is wet causes compaction of the subsoil. Tillage practices that leave crop residue on the surface help to control erosion, conserve moisture, improve tilth, and increase the rate of water intake. Contour farming, grassed waterways, and terracing also can help to control erosion, but most slopes are too short and irregular for contouring and terracing.

These soils are well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable.

These soils are suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well.

These soils are well suited to range. The native vegetation dominantly is western wheatgrass, needlegrasses, and blue grama. Overused areas are dominated by western wheatgrass. If overuse continues, blue grama and Kentucky bluegrass dominate the site.

Because of the shrink-swell potential, the Bearpaw soil is poorly suited and the Greenway soil only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, these soils are poorly suited to septic tank absorption fields. Enlarging the absorption area of the fields, however, helps to overcome the slow absorption of liquid waste.

The Bearpaw soil is in capability subclass IIIe, Clayey range site; the Greenway soil is in capability subclass IIe, Silty range site.

13E—Zahl-Kloten loams, 9 to 35 percent slopes. These well drained, strongly sloping to steep soils are on the sides of entrenched drainageways in the uplands. The deep Zahl soil is on the upper side slopes. The shallow Kloten soil is on the middle and lower side slopes. Areas are long and narrow and 10 to 160 acres in size. They are 45 to 55 percent Zahl soil and 20 to 30 percent Kloten soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Zahl soil is dark grayish brown and grayish brown loam about 6 inches thick. It is calcareous in the lower part. The underlying material to a depth of 60 inches is light gray and light brownish gray, calcareous clay loam. In places the surface layer is less than 6 inches thick.

Typically, the surface layer of the Kloten soil is gray loam about 6 inches thick. The underlying material, to a depth of 14 inches, is gray loam. Below this to a depth of 60 inches is gray, bedded shale. In some areas the shale is more than 14 inches from the surface. In other areas it is exposed.

Included with these soils in mapping are small areas of Parshall, Straw, and Tally soils. These included soils make up less than 25 percent of any one mapped area. Parshall and Tally soils contain more sand than the Zahl and Kloten soils. They occur as scattered areas adjacent to areas of the Zahl soil. The moderately well drained Straw soils are on narrow flood plains.

The content of organic matter is moderate and fertility medium in the Zahl and Kloten soils. Permeability is moderate in the upper part of the Zahl soil and moderately slow in the underlying material. It is moderate above the shale in the Kloten soil. Available water capacity is moderate or high in the Zahl soil and low in the Kloten soil. Runoff is rapid.

Most areas support native grass and are used for grazing. These soils are fairly well suited to range. The natural vegetation dominantly is little bluestem, western wheatgrass, needleandthread, and blue grama. Overused areas are dominated by needleandthread, blue grama, and sideoats grama. The areas where bedded shale is exposed are bare.

These soils generally are too steep for cultivated crops, tame pasture and hay, windbreaks and environmental plantings, building site development, and sanitary facilities. Also, the Kloten soil is shallow over bedrock.

The capability subclass is VIe; the Zahl soil is in Thin Upland range site, the Kloten soil in Shallow range site.

14D—Vida extremely stony loam, 3 to 15 percent slopes. This deep, well drained, undulating to rolling, extremely stony soil is on knolls, ridges, and side slopes in the uplands. Granitic rocks 1 to 3 feet in diameter cover 3 to 15 percent of the surface (fig. 4). A few large boulders are in some areas. Areas are long and narrow or irregular in shape and 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, extremely stony loam about 4 inches thick. The subsoil is dark grayish brown and light brownish gray, friable clay loam about 17 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. Stones make up 5 to 30 percent of the subsoil and underlying material. In places carbonates are below a depth of 10 inches. In some areas the subsoil contains less clay.

Included with this soil in mapping are small areas of Bowbells, Parnell, and Wabek soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Bowbells soils are in swales. They are dark to a depth of more than 16 inches. The very poorly drained Parnell soils are in depressions. Wabek soils have gravelly sand within a depth of 14 inches. They are on the higher parts of the landscape.

The content of organic matter is moderate and fertility medium in the Vida soil. Permeability is moderate in the surface layer and subsoil and moderately slow in the underlying material. Available water capacity is moderate or high. Runoff is medium. The shrink-swell potential is moderate.

All of the acreage supports native grasses and is used for grazing. This soil is well suited to range. The native vegetation dominantly is little bluestem, western wheatgrass, green needlegrass, needleandthread, and blue grama. Overused areas are dominated by western wheatgrass, needleandthread, sideoats grama, and weeds.

Figure 4.—Numerous stones in an area of Vida extremely stony loam, 3 to 15 percent slopes.

This soil is too stony for cultivated crops, tame pasture and hay, and windbreaks and environmental plantings. Removing the stones and boulders is impractical.

This soil generally is too steep and too stony for building site development and most sanitary facilities. The better suited adjacent soils should be selected as sites for these purposes.

The capability subclass is VIIs; Silty range site.

15A—Williams-Bowbells loams, 0 to 3 percent slopes. These deep, nearly level and very gently sloping soils are on uplands. The well drained Williams soil is on the middle and upper convex parts of the landscape. In some areas scattered stones are on the convex knolls and ridges. The moderately well drained Bowbells soil is in swales and on the lower slightly concave parts of the landscape. It is occasionally flooded for very brief periods. Areas are irregular in shape and 5 to more than 250 acres in size. They are 50 to 55 percent Williams soil and 25 to 30 percent Bowbells soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places lime is within a depth of 10 inches. In some areas the subsoil contains less clay.

Typically, the surface layer of the Bowbells soil is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with these soils in mapping are scattered small areas of Bryant and Niobell soils and small areas of Nishon and Tonka soils in depressions. These included soils make up less than 20 percent of any one mapped area. Bryant soils contain less sand and more

silt in the subsoil than the Williams soil. They occur as areas intermingled with some areas of the Williams soil. Niobell soils have a sodium affected subsoil. They are slightly lower on the landscape than the Williams soil. Nishon and Tonka soils are poorly drained.

The content of organic matter is moderate in the Williams soil and high in the Bowbells soil. Fertility is medium in the Williams soil and high in the Bowbells soil. Permeability is moderate in the subsoil of both soils and moderately slow in the underlying material. Available water capacity is high. The Bowbells soil has a water table at a depth of 4 to 6 feet during wet periods. Runoff is slow on both soils. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable. Because of the runoff from adjacent soils, planting and harvesting are delayed during some wet periods on the Bowbells soil. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface. In some areas surface stones hinder the use of farm machinery. They should be removed annually.

These soils are well suited to range. The native vegetation on the Williams soil dominantly is bluestems, western wheatgrass, and green needlegrass. That on the Bowbells soil is big bluestem and lesser amounts of green needlegrass and western wheatgrass. Overused areas are dominated by western wheatgrass, needleandthread, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. All of the climatically suited trees and shrubs grow well on the Williams soil, except for those that require an abundant supply of moisture. The Bowbells soil is especially well suited to those that require an abundant supply of moisture.

Because of the moderate shrink-swell potential, the Williams soil is only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. This soil is poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste. The Bowbells soil generally is unsuitable as a site for buildings and sanitary facilities because it is subject to flooding.

The capability subclass is IIc; the Williams soil is in Silty range site, the Bowbells soil in Overflow range site.

15B—Williams-Bowbells loams, 1 to 6 percent slopes. These deep, nearly level, gently sloping, and undulating soils are on uplands. The well drained Williams soil is in convex areas. In some of these areas scattered stones are on the surface and throughout the soil. The moderately well drained Bowbells soil is in swales. It is occasionally flooded for very brief periods. Areas are irregular in shape and 10 to more than 1,500 acres in size. They are 50 to 60 percent Williams soil and 20 to 30 percent Bowbells soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places lime is within a depth of 10 inches. In some areas the subsoil contains less clay.

Typically, the surface layer of the Bowbells soil is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with these soils in mapping are small areas of Bryant, Niobell, Nishon, and Tonka soils. These included soils make up less than 20 percent of any one mapped area. Bryant soils contain less clay in the subsoil than the Williams soil. They occur as areas intermingled with some areas of the Williams soil. Niobell soils have a sodium affected subsoil. They are slightly lower on the landscape than the Williams soil. The poorly drained Nishon and Tonka soils are in depressions.

The content of organic matter is moderate in the Williams soil and high in the Bowbells soil. Fertility is medium in the Williams soil and high in the Bowbells soil. Runoff is medium on the Williams soil and slow on the Bowbells soil. Permeability is moderate in the subsoil of both soils and moderately slow in the underlying material. Available water capacity is high. The Bowbells soil has a water table at a depth of 4 to 6 feet during wet periods. The shrink-swell potential is moderate in both soils.

Most of the acreage is cropland. These soils are well suited to cultivated crops. Because of the runoff from adjacent soils, planting and harvesting are delayed during some wet periods on the Bowbells soil. The additional moisture is beneficial, however, in most years. The main concerns of management are controlling erosion and conserving moisture. Tillage practices that leave crop residue on the surface help to control erosion, conserve moisture, and maintain fertility. Contour farming and terraces also can help to control erosion, but in most areas slopes are too short and too irregular for contouring and terracing. Grassed waterways help to keep gullies from forming. In some areas the surface stones hinder the use of farm machinery. They should be removed annually.

These soils are well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable.

These soils are well suited to range. The native vegetation on the Williams soil dominantly is bluestems, western wheatgrass, and green needlegrass. That on the Bowbells soil is big bluestem and lesser amounts of green needlegrass and western wheatgrass. Overused areas are dominated by western wheatgrass, needleandthread, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. All of the climatically suited trees and shrubs grow well on the Williams soil, except for those that require an abundant supply of moisture. The Bowbells soil is especially well suited to those that require an abundant supply of moisture.

Because of the moderate shrink-swell potential, the Williams soil is only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. This soil is poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste. The Bowbells soil generally is unsuitable as a site for buildings and sanitary facilities because it is subject to flooding.

The Williams soil is in capability subclass IIe, Silty range site; the Bowbells soil is in capability subclass IIc, Overflow range site.

15C—Williams-Bowbells loams, 2 to 9 percent slopes. These deep, nearly level to moderately sloping or gently rolling soils are on uplands. The moderately sloping areas are long and narrow and are on the sides and around the head of small drainageways. The well drained Williams soil is in the higher convex areas. In some of these areas scattered stones are on the surface. The moderately well drained Bowbells soil is on the lower side slopes and in swales. It is occasionally flooded for very brief periods. Areas are irregular in shape and range from 10 to 160 acres in size. They are 50 to 60 percent Williams soil and 20 to 30 percent Bowbells soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places lime is within a depth of 10 inches. In some areas the subsoil contains less clay.

Typically, the surface layer of the Bowbells soil is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with these soils in mapping are small areas of Lehr, Tonka, and Zahl soils. These included soils make up less than 20 percent of any one mapped area. Lehr soils are 14 to 20 inches deep over gravelly sand. They occur as scattered areas adjacent to areas of the Williams soil. The poorly drained Tonka soils are in depressions. Zahl soils have carbonates near the surface. They are on the upper side slopes and on convex ridges.

The content of organic matter is moderate in the Williams soil and high in the Bowbells soil. Fertility is medium in the Williams soil and high in the Bowbells soil. Permeability is moderate in the subsoil of both soils and moderately slow in the underlying material. Available water capacity is high. The Bowbells soil has a water table at a depth of 4 to 6 feet during wet periods. Runoff is medium on the Williams soil and slow on the Bowbells soil. The shrink-swell potential is moderate in both soils.

Most of the acreage is cropland. The Williams soil is fairly well suited and the Bowbells soil well suited to cultivated crops. Both soils are well suited to tame pasture and hay. Because of the runoff from adjacent soils, planting and harvesting are delayed during some wet periods on the Bowbells soil. The additional moisture is beneficial, however, in most years. Measures that control erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface. Contour farming and terraces also help to control erosion, but in most areas slopes are too short or too irregular for contouring and terracing. Grassed waterways help to keep gullies from forming. In some areas the surface stones hinder the use of farm machinery. They should be removed annually.

These soils are well suited to range. The native vegetation on the Williams soil dominantly is bluestems, western wheatgrass, and green needlegrass. That on the Bowbells soil is big bluestem and lesser amounts of green needlegrass and western wheatgrass. Overused areas are dominated by western wheatgrass, needleandthread, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well on the Williams soil, except for those that require an abundant supply of moisture. The Bowbells soil is especially well suited to those that require an abundant supply of moisture. Planting on the contour helps to control erosion and conserves moisture.

Because of the moderate shrink-swell potential, the Williams soil is only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage

caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

The Williams soil is poorly suited to septic tank absorption fields because of the restricted permeability and the slope. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste. Also, land shaping and installing the distribution lines across the slope improve the efficiency of the absorption system.

The Bowbells soil generally is unsuitable as a site for buildings and sanitary facilities because it is subject to flooding.

The Williams soil is in capability subclass IIIe, Silty range site; the Bowbells soil is in capability subclass IIc, Overflow range site.

16A—Williams-Bowbells-Tonka complex, 0 to 3 percent slopes. These deep, nearly level and gently undulating soils are on uplands. The well drained Williams soil is on slight rises, the moderately well drained Bowbells soil is in swales, and the poorly drained Tonka soil is in depressions. The Bowbells soil is occasionally flooded for very brief periods. The Tonka soil is ponded for long periods. In the convex areas scattered stones are on the surface. Areas are irregular in shape and 60 to more than 1,000 acres in size. They are 45 to 55 percent Williams soil, 20 to 25 percent Bowbells soil, and 10 to 15 percent Tonka soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places lime is within a depth of 10 inches. In some areas the subsoil contains less clay.

Typically, the surface layer of the Bowbells soil is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Typically, the surface layer of the Tonka soil is dark gray silt loam about 8 inches thick. The subsurface layer is light gray loam about 4 inches thick. The subsoil is about 30 inches of dark gray, grayish brown, and light brownish gray, firm silty clay and silty clay loam. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light gray, calcareous clay loam.

Included with these soils in mapping are small areas of Cresbard, Niobell, Nishon, and Noonan soils. These included soils make up less than 15 percent of any one mapped area. Cresbard, Niobell, and Noonan soils have a sodium affected subsoil. Cresbard soils are in swales, Niobell soils are on flats and slight rises, and Noonan soils are in small depressions. Nishon soils are in depressions. Their surface layer is 1 to 4 inches thick.

The content of organic matter is moderate in the Williams soil and high in the Bowbells and Tonka soils. Fertility is medium in the Williams soil and high in the Bowbells and Tonka soils. Permeability is moderate in the subsoil of the Williams and Bowbells soils and moderately slow in the underlying material. It is slow in the Tonka soil. Available water capacity is high in all of the soils. During wet periods, the water table in the Bowbells soil is at a depth of 4 to 6 feet and that in the Tonka soil is 0.5 foot above the surface or within a depth of 1 foot. Runoff is slow on the Williams and Bowbells soils and ponded on the Tonka soil. The shrink-swell potential is moderate in the Williams and Bowbells soils and high in the Tonka soil.

Most of the acreage supports native grasses and is used for grazing. These soils are well suited to range. The native vegetation on the Williams and Bowbells soils dominantly is bluestems, western wheatgrass, and green needlegrass. That on the Tonka soil dominantly is sedges and lesser amounts of reedgrass and prairie cordgrass. Overused areas of the Williams and Bowbells soils are dominated by western wheatgrass, needleandthread, and Kentucky bluegrass. During dry periods overused areas of the Tonka soil are dominated by foxtail barley, Kentucky bluegrass, and curlycup gumweed. Smartweed, less palatable sedges, and rushes increase in abundance during wet periods. This poorly drained soil is a good site for dugouts that provide water for livestock.

The Williams and Bowbells soils are well suited to cultivated crops, but the Tonka soil is poorly suited because of the wetness. Because of the runoff from the Williams soil, planting and harvesting are delayed in some areas of the Bowbells and Tonka soils. Conserving moisture in the Bowbells and Williams soils and controlling the wetness of the Tonka soil are the main concerns of management. Tillage practices that leave crop residue on the surface conserve moisture and improve fertility. In some areas of the Williams soil, the surface stones hinder the use of farm machinery. They should be removed annually.

The Williams and Bowbells soils are well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable. The Tonka soil is only fairly well suited to tame pasture and hay because of the ponding. The choice of tame pasture plants is limited to water tolerant species, such as Garrison creeping foxtail and reed canarygrass.

The Williams and Bowbells soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well on the Williams soil, except for those that require an abundant supply of moisture. The Bowbells soil is especially well suited to those that require an abundant moisture supply. The

Tonka soil generally is unsuited to windbreaks and environmental plantings unless it is drained.

Because of the moderate shrink-swell potential, the Williams soil is only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. This soil is poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste.

The Bowbells and Tonka soils generally are unsuitable as sites for buildings and sanitary facilities. The Bowbells soil is subject to flooding and the Tonka soil to ponding.

The Williams soil is in capability subclass IIc, Silty range site; the Bowbells soil is in capability subclass IIc, Overflow range site; and the Tonka soil is in capability subclass IVw, Wet Meadow range site.

16B—Williams-Bowbells-Tonka complex, 1 to 6 percent slopes. These deep, level to undulating soils are on uplands. The well drained Williams soil is in the higher convex areas, where scattered stones generally are on the surface. The moderately well drained Bowbells soil is in swales. It is occasionally flooded for very brief periods. The poorly drained Tonka soil is in depressions. It is ponded during spring runoff and after heavy rains. Areas are irregular in shape and 60 to more than 1,000 acres in size. They are 40 to 50 percent Williams soil, 20 to 25 percent Bowbells soil, and 10 to 15 percent Tonka soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places lime is within a depth of 10 inches. In some areas the subsoil contains less clay.

Typically, the surface layer of the Bowbells soil is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Typically, the surface layer of the Tonka soil is dark gray silt loam about 8 inches thick. The subsurface layer is light gray loam about 4 inches thick. The subsoil is about 30 inches of dark gray, grayish brown, and light brownish gray, firm silty clay and silty clay loam. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light gray, calcareous clay loam.

Included with these soils in mapping are small areas of Cresbard, Lehr, Niobell, Nishon, and Noonan soils. These included soils make up less than 20 percent of any one mapped area. Cresbard, Niobell, and Noonan soils have a sodium affected subsoil. Cresbard soils are in swales, Niobell soils are slightly lower on the landscape than the Williams soil, and Noonan soils are in small depressions. Lehr soils are 14 to 20 inches deep over gravelly sand. They are on convex ridges and knolls. Nishon soils are in depressions. Their surface layer is 1 to 4 inches thick.

The content of organic matter is moderate in the Williams soil and high in the Bowbells and Tonka soils. Fertility is medium in the Williams soil and high in the Bowbells and Tonka soils. Permeability is moderate in the subsoil of the Williams and Bowbells soils and moderately slow in the underlying material. It is slow in the Tonka soil. Available water capacity is high in all of the soils. During wet periods, the water table in the Bowbells soil is at a depth of 4 to 6 feet and that in the Tonka soil is 0.5 foot above the surface or within a depth of 1 foot. Runoff is medium on the Williams soil, slow on the Bowbells soil, and ponded on the Tonka soil. The shrink-swell potential is moderate in the Williams and Bowbells soils and high in the Tonka soil.

Most of the acreage supports native grasses and is used for grazing. These soils are well suited to range. The native vegetation on the Williams and Bowbells soils dominantly is bluestems, western wheatgrass, and green needlegrass. That on the Tonka soil dominantly is sedges and lesser amounts of reedgrass and prairie cordgrass. Overused areas of the Williams and Bowbells soils are dominated by western wheatgrass, needleandthread, Kentucky bluegrass, and weeds. During dry periods overused areas of the Tonka soil are dominated by foxtail barley, Kentucky bluegrass, and curlycup gumweed. Smartweed, less palatable sedges, and rushes increase in abundance during wet periods. This poorly drained soil is a good site for dugouts that provide water for livestock.

The Williams and Bowbells soils are well suited to cultivated crops, but the Tonka soil is poorly suited because of the wetness. Because of the runoff from the Williams soil, planting and harvesting are delayed in some areas of the Bowbells and Tonka soils. Controlling erosion and conserving moisture in areas of the Williams soil, conserving moisture in the Bowbells soil, and controlling the wetness of the Tonka soil are the main concerns of management. Tillage practices that leave crop residue on the surface help to control erosion and conserve moisture. Slopes are too short and too irregular in most areas for contour farming and terraces. Grassed waterways help to keep gullies from forming. In some areas of the Williams soil, the surface stones hinder the use of farm machinery. They should be removed annually.

The Williams and Bowbells soils are well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass,

and smooth bromegrass are suitable. The Tonka soil is only fairly well suited to tame pasture and hay because of the ponding. The choice of pasture plants is limited to water tolerant species, such as Garrison creeping foxtail and reed canarygrass.

The Williams and Bowbells soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well on the Williams soil, except for those that require an abundant supply of moisture. The Bowbells soil is especially well suited to those that require an abundant moisture supply. The Tonka soil generally is unsuited to windbreaks and environmental plantings unless it is drained.

Because of the moderate shrink-swell potential, the Williams soil is only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. This soil is poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste.

The Bowbells and Tonka soils generally are unsuitable as sites for buildings and sanitary facilities. The Bowbells soil is subject to flooding and the Tonka soil to ponding.

The Williams soil is in capability subclass IIe, Silty range site; the Bowbells soil is in capability subclass IIc, Overflow range site; and the Tonka soil is in capability subclass IVw, Wet Meadow range site.

16C—Williams-Bowbells-Parnell complex, 1 to 9 percent slopes. These deep, level to gently rolling soils are on uplands. The well drained Williams soil is in the higher convex areas, where scattered stones generally are on the surface. The moderately well drained Bowbells soil is on the lower side slopes and in swales. It is occasionally flooded for very brief periods. The poorly drained Parnell soil is in depressions. It is ponded for long periods. Areas are irregular in shape and 40 to 300 acres in size. They are 40 to 50 percent Williams soil, 20 to 30 percent Bowbells soil, and 10 to 15 percent Parnell soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places lime is within a depth of 10 inches. In some areas the subsoil contains less clay.

Typically, the surface layer of the Bowbells soil is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Typically, the surface layer of the Parnell soil is dark gray silty clay loam about 7 inches thick. The subsoil is dark gray and gray, firm silty clay about 38 inches thick. The underlying material to a depth of 60 inches is gray silty clay. In places clay loam glacial till is below a depth of 40 inches.

Included with these soils in mapping are small areas of Lehr, Nishon, Tonka, Vallers, and Zahl soils. These included soils make up less than 20 percent of any one mapped area. Lehr soils are 14 to 20 inches deep over gravelly sand. They occur as scattered areas adjacent to areas of the Williams soil. Nishon, Tonka, and Vallers soils are poorly drained. Nishon and Tonka soils are in depressions, and Vallers soils are near the outer edges of the areas of Parnell soil. The well drained Zahl soils are on the upper side slopes and on convex ridges. They have carbonates near the surface.

The content of organic matter is moderate in the Williams soil and high in the Bowbells and Parnell soils. Fertility is medium in the Williams soil and high in the Bowbells and Parnell soils. Permeability is moderate in the subsoil of the Williams and Bowbells soils and moderately slow in the underlying material. It is slow in the Parnell soil. Available water capacity is high in the Williams and Bowbells soils and moderate or high in the Parnell soil. During wet periods, the water table in the Bowbells soil is at a depth of 4 to 6 feet and that in the Parnell soil is as much as 2 feet above the surface or as much as 2 feet below. Runoff is medium on the Williams soil, slow on the Bowbells soil, and ponded on the Parnell soil. The shrink-swell potential is moderate in the Williams and Bowbells soils and high in the Parnell soil.

Most of the acreage supports native grasses and is used for grazing. The Williams and Bowbells soils are well suited and the Parnell soil fairly well suited to range. The native vegetation on the Williams and Bowbells soils dominantly is bluestems, western wheatgrass, and green needlegrass. That on the Parnell soil dominantly is prairie cordgrass, rivergrass, and sedges. Overused areas of the Williams and Bowbells soils are dominated by western wheatgrass, needleandthread, Kentucky bluegrass, and weeds. Overused areas of the Parnell soil are dominated by Kentucky bluegrass, saltgrass, sedges, and rushes. This poorly drained soil is a good site for dugouts that provide water for livestock.

The Williams soil is fairly well suited and the Bowbells soil well suited to cultivated crops. The Parnell soil, however, generally is unsuited because of the wetness. Fieldwork is delayed on the Bowbells soil during some wet periods. Measures that control erosion on the Williams soil and conserve moisture in the Bowbells soil are the main management needs. Examples are tillage practices that leave crop residue on the surface. Contour farming and terraces also can help to control erosion and conserve moisture, but slopes generally are too irregular and too short for contouring and terracing.

Grassed waterways help to keep gullies from forming. In some areas of the Williams soil, the surface stones hinder the use of farm machinery. They should be removed annually.

The Williams and Bowbells soils are well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable. The Parnell soil is only fairly well suited to tame pasture and hay because of the wetness. The choice of tame pasture plants is limited to water tolerant species. Garrison creeping foxtail and reed canarygrass are examples.

The Williams and Bowbells soils are suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well on the Williams soil, except for those that require an abundant supply of moisture. The Bowbells soil is well suited to the trees and shrubs that require an abundant moisture supply. The Parnell soil generally is unsuited to windbreaks and environmental plantings because of the ponding.

The Williams soil is fairly well suited to building site development. The moderate shrink-swell potential is the main limitation. Also, the slope is a limitation on sites for small commercial buildings. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Small commercial buildings should be designed to conform to the natural slope of the land. Land shaping is needed in some areas.

The Williams soil is poorly suited to septic tank absorption fields because of the restricted permeability and the slope. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste. Also, land shaping and installing the distribution lines across the slope improve the efficiency of the absorption system.

The Bowbells and Parnell soils generally are unsuitable as sites for buildings and sanitary facilities. The Bowbells soil is subject to flooding and the Parnell soil to ponding.

The Williams soil is in capability subclass IIIe, Silty range site; the Bowbells soil is in capability subclass IIc, Overflow range site; and the Parnell soil is in capability subclass Vw, Shallow Marsh range site.

17B—Vida-Williams loams, 3 to 6 percent slopes. These deep, well drained, undulating soils are on uplands. The Vida soil is on the upper convex sides and tops of low rises, and the Williams soil is on the lower and middle slopes. In many areas scattered stones are on the surface. Areas are irregular in shape and 10 to 200 acres in size. They are 45 to 55 percent Vida soil and 35 to 45 percent Williams soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Vida soil is dark grayish brown loam about 4 inches thick. The subsoil is dark grayish brown and light brownish gray, friable clay loam about 17 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places the surface layer and the upper part of the subsoil are calcareous.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places the subsoil contains less clay.

Included with these soils in mapping are small areas of the moderately well drained Bowbells soils in swales. These included soils make up about 15 percent of any one mapped area.

The content of organic matter is moderate and fertility medium in the Vida and Williams soils. Permeability is moderate in the subsoil and moderately slow in the underlying material. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are fairly well suited to cultivated crops and to tame pasture and hay. Alfalfa, crested wheatgrass, intermediate wheatgrass, and smooth bromegrass are suitable. The high content of lime near the surface of the Vida soil adversely affects the availability of plant nutrients. Erosion on many of the convex knobs and ridges reduces yields. Measures that conserve moisture, control erosion, and improve fertility are the main management needs. Examples are tillage practices that leave crop residue on the surface. Contour farming and terracing also can help to control erosion and conserve moisture, but in most areas slopes are too short and too irregular for contouring and terracing. Grassed waterways help to keep gullies from forming.

These soils are well suited to range. The native vegetation dominantly is bluestems, green needlegrass, western wheatgrass, and needleandthread. Overused areas are dominated by western wheatgrass, needleandthread, and blue grama.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, except for those that require an abundant supply of moisture.

Because of the moderate shrink-swell potential, these soils are only fairly well suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. The soils are poorly suited to

septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields helps to overcome the slow absorption of liquid waste.

The capability subclass is IIIe; Silty range site.

17C—Vida-Williams-Bowbells loams, 2 to 15 percent slopes. These deep, gently undulating to rolling soils are on uplands. The well drained Vida soil is on the upper convex sides and tops of knolls and ridges. The well drained Williams soil is on the middle slopes. The moderately well drained Bowbells soil is on the lower side slopes and in swales. It is occasionally flooded for very brief periods. Scattered stones are on the surface in most areas of the Vida and Williams soils. In some areas they cover 3 to 10 percent of the surface. In some areas a few large boulders are on the surface. Areas are irregular in shape and 10 to more than 1,000 acres in size. They are 35 to 45 percent Vida soil, 25 to 35 percent Williams soil, and 15 to 20 percent Bowbells soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Vida soil is dark grayish brown loam about 4 inches thick. The subsoil is dark grayish brown and light brownish gray, friable clay loam about 17 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places the surface layer and the upper part of the subsoil are calcareous.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous loam.

Typically, the surface layer of the Bowbells soil is dark gray loam about 11 inches thick. The subsoil is dark grayish brown and grayish brown, friable clay loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with these soils in mapping are small areas of Parnell, Tonka, Wabek, Zahill, and Zahl soils. These included soils make up less than 10 percent of any one mapped area. The very poorly drained Parnell and poorly drained Tonka soils are in depressions. Wabek soils are shallow to gravelly sand. They are on knobs and ridgetops. Zahill soils are on the higher parts of the landscape. They have lime at the surface. Zahl soils also have lime near the surface. They occur as areas intermingled with areas of the Vida soil.

The content of organic matter is moderate in the Williams and Vida soils and high in the Bowbells soil. Fertility is medium in the Vida and Williams soils and high in the Bowbells soil. Permeability is moderate in the subsoil of all three soils and moderately slow in the underlying material. Available water capacity is high. The Bowbells soil has a water table at a depth of 4 to 6 feet during wet periods. Runoff is medium on the Vida and Williams soils and slow on the Bowbells soil. The shrink-swell potential is moderate in all three soils.

Most of the acreage supports native grasses and is used for grazing. These soils are well suited to range. The native vegetation on the Vida and Williams soils dominantly is bluestems, western wheatgrass, and green needlegrass. That on the Bowbells soil dominantly is big bluestem and lesser amounts of green needlegrass and western wheatgrass. Overused areas are dominated by western wheatgrass, needleandthread, blue grama, and Kentucky bluegrass.

These soils are poorly suited to cultivated crops. The lime near the surface of the Vida soil adversely affects the availability of plant nutrients. Measures that control erosion and improve fertility are the main management needs. Examples are tillage practices that leave crop residue on the surface. Contour farming and terraces also can help to control erosion, but in most areas slopes are too short and too irregular for contouring and terracing. Grassed waterways help to keep gullies from forming. Including grasses and legumes in the cropping system improves fertility and increases the content of organic matter. In some areas the surface stones hinder the use of farm machinery. They should be removed annually.

A cover of tame pasture plants or hay is effective in controlling erosion. These soils are well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well on the Vida and Williams soils, except for those that require an abundant supply of moisture. The Bowbells soil is especially well suited to those that require an abundant moisture supply. Planting on the contour helps to control erosion and conserves moisture.

Because of the moderate shrink-swell potential and the slope, the Vida and Williams soils are only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. The buildings should be designed to conform to the natural slope of the land. In some areas land shaping is needed.

The Vida and Williams soils are poorly suited to septic tank absorption fields because of the restricted permeability and the slope. The absorption fields should be installed in the less sloping areas. Land shaping and installing the distribution lines across the slope improve the efficiency of the absorption system. Enlarging the absorption area in these fields helps to overcome the slow absorption of liquid waste.

The Bowbells soil generally is unsuitable as a site for buildings and sanitary facilities because it is subject to flooding.

The Vida soil is in capability subclass IVe, the Williams soil in capability subclass IIIe, and the Bowbells soil in capability subclass IIc; the Vida and Williams soils are in Silty range site and the Bowbells soil in Overflow range site.

17D—Vida-Zahl loams, 6 to 15 percent slopes. These deep, well drained, moderately sloping and strongly sloping or rolling soils are on uplands. The Vida soil is on the lower and middle slopes. The Zahl soil is on the upper convex sides and tops of knolls and low hills. In most areas scattered stones are on the surface. Areas are irregular in shape and 10 to more than 150 acres in size. They are 50 to 60 percent Vida soil and 20 to 30 percent Zahl soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Vida soil is dark grayish brown loam about 4 inches thick. The subsoil is grayish brown and light brownish gray, friable clay loam about 17 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places, the depth to the underlying material is greater and carbonates are leached to a greater depth. In some areas the subsoil contains less clay.

Typically, the surface layer of the Zahl soil is dark grayish brown and grayish brown loam about 6 inches thick. The underlying material to a depth of 60 inches is light gray and light brownish gray, calcareous clay loam. In places, the surface layer is less than 6 inches thick and carbonates are at or near the surface.

Included with these soils in mapping are small areas of Bowbells, Tonka, and Wabek soils. These included soils make up less than 20 percent of any one mapped area. The moderately well drained Bowbells soils are in swales. The poorly drained Tonka soils are in depressions. Wabek soils are on convex ridges. They have gravelly sand within a depth of 14 inches.

The content of organic matter is moderate and fertility medium in the Vida and Zahl soils. Permeability is moderate in the upper part of the soils and moderately slow in the underlying material. Available water capacity is moderate or high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage supports native grasses and is used for grazing. The Vida soil is well suited and the Zahl soil fairly well suited to range. The native vegetation on the Vida soil dominantly is little bluestem, western wheatgrass, and green needlegrass. That on the Zahl soil is little bluestem, sideoats grama, western wheatgrass, and needleandthread. Overused areas are dominated by western wheatgrass, needleandthread, and blue grama.

The Vida soil is poorly suited and the Zahl soil generally unsuited to cultivated crops. The main concerns of management are controlling erosion and improving fertility. Tillage practices that leave crop residue on the surface conserve moisture, improve fertility, and help to control erosion.

These soils are fairly well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable.

The Vida soil is better suited to windbreaks and environmental plantings than the Zahl soil. All climatically suited trees and shrubs grow well on the Vida soil, except for those that require an abundant supply of moisture. Optimum growth and survival, however, are unlikely on the Zahl soil. Planting on the contour helps to control erosion and conserves moisture.

Because of the moderate shrink-swell potential and the slope, these soils are only fairly well suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. The buildings should be designed to conform to the natural slope of the land. In some areas land shaping is needed.

These soils generally are too steep for most sanitary facilities. Septic tank absorption fields should be installed in the less sloping areas. Enlarging the absorption area in these fields helps to overcome the slow absorption of liquid waste. Land shaping and installing the distribution lines across the slope improve the efficiency of the absorption system.

The Vida soil is in capability subclass IVe, Silty range site; the Zahl soil is in capability subclass VIe, Thin Upland range site.

17E—Vida-Zahill loams, 15 to 25 percent slopes. These deep, well drained, moderately steep and hilly soils are on uplands. The Vida soil is on the lower and middle slopes. The Zahill soil is on the upper convex sides and tops of ridges and knolls. Scattered stones are on the surface in most areas. In some areas they are only 1 to 5 feet apart. In some areas a few large boulders are on the surface. Areas are long and narrow or irregular in shape and are 20 to 160 acres in size. They are 40 to 50 percent Vida soil and 35 to 45 percent Zahill soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Vida soil is dark grayish brown loam about 4 inches thick. The subsoil is grayish brown and light brownish gray, friable clay loam about 17 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places, the depth to the underlying material is greater and carbonates are leached to a greater depth.

Typically, the surface layer of the Zahill soil is dark grayish brown loam about 3 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous loam and clay loam. In places the dark surface layer is more than 3 inches thick.

Included with these soils in mapping are small areas of Bowbells, Parnell, Wabek, and Williams soils. These included soils make up less than 20 percent of any one mapped area. The moderately well drained Bowbells soils are in swales. The very poorly drained Parnell soils are in depressions. Wabek soils have gravelly sand within a depth of 14 inches. They occur as small pockets and bands intermingled with some areas of the Zahill soil.

The content of organic matter is moderate in the Vida soil and low in the Zahill soil. Fertility is medium in the Vida soil and low in the Zahill soil. Permeability is moderate in the subsoil of the Vida soil and moderately slow in the underlying material. It is moderately slow in the Zahill soil. Available water capacity is moderate or high in both soils. Runoff is medium on the Vida soil and rapid on the Zahill soil. The shrink-swell potential is moderate in both soils.

Most of the acreage supports native grasses and is used for grazing. The Vida soil is well suited and the Zahill soil fairly well suited to range. The native vegetation on the Vida soil dominantly is little bluestem, western wheatgrass, and green needlegrass. That on the Zahill soil dominantly is little bluestem, sideoats grama, western wheatgrass, and needleandthread. Overused areas are dominated by needleandthread, sideoats grama, and blue grama.

These soils generally are too steep and too thin over the underlying material for cultivated crops, tame pasture and hay, and windbreaks and environmental plantings. Also, they are too steep for building site development and most sanitary facilities.

The capability subclass is VIe; the Vida soil is in Silty range site and the Zahill soil in Thin Upland range site.

18A—Williams-Niobell loams, 0 to 3 percent slopes. These deep, nearly level and gently undulating soils are on uplands. The well drained Williams soil is on the convex parts of the landscape. The moderately well drained Niobell soil is in swales and on flats. In some areas scattered stones are on the surface. Areas are irregular in shape and 15 to more than 1,000 acres in size. They are 50 to 60 percent Williams soil and 25 to 35 percent Niobell soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is dark grayish brown loam about 6 inches thick. The subsoil is dark grayish brown, brown, and light brownish gray, friable clay loam about 19 inches thick. In the lower part it has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places lime is within a depth of 10 inches.

Typically, the surface layer of the Niobell soil is dark grayish brown loam about 7 inches thick. Below this is a transitional layer of dark grayish brown and grayish brown loam about 6 inches thick. The subsoil is grayish brown, pale brown, and light brownish gray, firm clay loam about 18 inches thick. In the lower part it has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray and light yellowish brown, calcareous clay loam. In places the subsoil contains more clay.

Included with these soils in mapping are small areas of Bowbells, Nishon, and Tonka soils. These included soils make up less than 15 percent of any one mapped area. Bowbells soils are dark to a depth of more than 16 inches. They are in swales. The poorly drained Nishon and Tonka soils are in small depressions.

The content of organic matter is moderate and fertility medium in the Williams and Niobell soils. Permeability is moderate in the subsoil of the Williams soil and moderately slow in the underlying material. It is slow in the Niobell soil. Available water capacity is high in the Williams soil and moderate or high in the Niobell soil. Runoff is slow on both soils. The shrink-swell potential is moderate in the Williams soil and high in the Niobell soil.

Most of the acreage is cropland. The Williams soil is well suited and the Niobell soil fairly well suited to cultivated crops. The Niobell soil is better suited to small grain than to row crops. Conserving moisture is the main concern in managing the Williams soil for crops. Conserving moisture, increasing the rate of water intake, and improving tilth are the main concerns in managing the Niobell soil. This soil has a claypan subsoil that takes in water slowly and releases it slowly to plants. Tillage practices that leave crop residue on the surface conserve moisture. Chiseling and subsoiling and including grasses and legumes in the cropping system increase the rate of water intake and improve tilth.

These soils are well suited to tame pasture and hay. Alfalfa, smooth bromegrass, crested wheatgrass, and intermediate wheatgrass are suitable.

These soils are well suited to range. The native vegetation dominantly is green needlegrass and western wheatgrass. Overused areas are dominated by needlegrass, blue grama, and Kentucky bluegrass.

The Williams soil is well suited and the Niobell soil fairly well suited to field windbreaks and environmental plantings. Most of the climatically suited trees and shrubs grow well, except for those that require an abundant supply of moisture.

Because of the moderate shrink-swell potential, these soils are only fairly well suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, these soils are poorly suited to septic tank absorption fields. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste.

The Williams soil is in capability subclass IIc, Silty range site; the Niobell soil is in capability subclass IIIs, Clayey range site.

20A—Lehr loam, 0 to 3 percent slopes. This somewhat excessively drained, nearly level and very gently sloping soil is on outwash plains and terraces. It is shallow over gravelly sand. Areas are irregular in shape and 10 to 275 acres in size. Slopes are smooth or slightly convex.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is brown, friable loam about 10 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sand. In places the depth to gravelly sand is more than 20 inches.

Included with this soil in mapping are small areas of Bowdle and Wabek soils. These soils make up less than 10 percent of any one mapped area. Bowdle soils are in swales. They are deeper to gravelly sand than the Lehr soil. Wabek soils are on the tops of low knolls. They are shallower to gravelly sand than the Lehr soil.

The content of organic matter is moderate and fertility medium in the Lehr soil. Permeability is moderately rapid in the subsoil and rapid or very rapid in the underlying gravelly sand. Available water capacity is low. Runoff is slow. The porous underlying material restricts the penetration of plant roots.

Most of the acreage is cropland. This soil is poorly suited to cultivated crops. It is droughty because it is shallow to gravelly sand. It is best suited to early maturing small grain. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface.

This soil is fairly well suited to tame pasture and hay. The low available water capacity and the shallow root zone, however, limit the choice of pasture plants. Crested wheatgrass is the best suited species.

This soil is suited to range. The native vegetation dominantly is needleandthread, western wheatgrass, and grama grasses. Overused areas are dominated by threadleaf sedge, blue grama, and weeds.

Because it is droughty and has a shallow root zone, this soil is poorly suited to windbreaks and environmental plantings. Carefully selected trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs the effluent from septic tank abosorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soil is a probable source of sand and gravel for use as road construction material.

The capability subclass is IVs; Shallow to Gravel range site.

20B—Lehr loam, 3 to 6 percent slopes. This somewhat excessively drained, gently sloping soil is on outwash plains and terraces. It is shallow over gravelly sand. Areas are irregular in shape and 5 to 200 acres in size. Slopes are smooth or slightly convex.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is brown, friable loam about 10 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sand. In places the depth to gravelly sand is more than 20 inches.

Included with this soil in mapping are small areas of Bowdle and Wabek soils. These soils make up less than 15 percent of any one mapped area. Bowdle soils are in swales. They are deeper to gravelly sand than the Lehr soil. Wabek soils are on the tops of knolls. They are shallower to gravelly sand than the Lehr soil.

The content of organic matter is moderate and fertility medium in the Lehr soil. Permeability is moderately rapid in the subsoil and rapid or very rapid in the underlying gravelly sand. Available water capacity is low. Runoff is slow. The porous underlying material restricts the penetration of plant roots.

Most of the acreage is cropland. This soil is poorly suited to cultivated crops. It is droughty because it is shallow to gravelly sand. It is best suited to early maturing small grain. Measures that conserve moisture and control erosion are the main management needs. Examples are tillage practices that leave crop residue on the surface. Grassed waterways help to keep gullies from forming.

This soil is fairly well suited to tame pasture and hay. The shallow root zone and the low available water capacity limit the choice of pasture plants and productivity. Crested wheatgrass is the best suited species.

This soil is suited to range. The native vegetation dominantly is needleandthread, western wheatgrass, and grama grasses. Overused areas are dominated by threadleaf sedge, blue grama, and weeds.

Because it is droughty and has a shallow root zone, this soil is poorly suited to windbreaks and environmental plantings. Carefully selected trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soil is a probable source of sand and gravel for use as road construction material.

The capability subclass is IVe; Shallow to Gravel range site.

21A—Cavour-Miranda loams, 1 to 5 percent slopes. These deep, moderately well drained, nearly level to undulating soils are on uplands. The Cavour soil is on the smooth or slightly concave parts of the landscape. The Miranda soil is in microdepressions. A few scattered stones are on the surface in places. Areas are irregular in shape and 5 to 300 acres in size. They are 45 to 55 percent Cavour soil and 30 to 40 percent Miranda soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Cavour soil is dark gray, friable loam about 9 inches thick. The subsurface layer is gray loam about 2 inches thick. The subsoil is about 21 inches of dark gray and olive gray, firm clay and clay loam. It has visible salt crystals in the lower part. The underlying material to a depth of 60 inches is light olive gray, calcareous clay loam that has accumulations of carbonate and visible salt crystals and nests of gypsum.

Typically, the surface layer of the Miranda soil is grayish brown loam about 2 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray, firm clay loam about 11 inches thick. In the lower part it is calcareous and has nests of salt. The underlying material to a depth of 60 inches is grayish brown and light brownish gray clay loam that has nests of salt and gypsum.

Included with these soils in mapping are small areas of Cresbard and Heil soils. These included soils make up less than 15 percent of any one mapped area. Cresbard soils do not have columnar structure in the subsoil. They are slightly higher on the landscape than the Cavour soil. The poorly drained Heil soils are in depressions.

The content of organic matter is moderate in the Cavour and Miranda soils. Fertility is medium in the Cavour soil and low or medium in the Miranda soil. Both soils have a sodium affected subsoil that restricts root penetration. Permeability is slow or very slow in the subsoil of the Cavour soil and moderately slow or slow in the underlying material. It is very slow in the Miranda soil. Available water capacity is moderate in both soils. Runoff is slow or medium. The shrink-swell potential is high in the subsoil of the Cavour soil and moderate in the underlying material. It is moderate in the Miranda soil.

Most of the acreage supports native grasses and is used for grazing. The Cavour soil is fairly well suited to range, but the Miranda soil is poorly suited. The main limitation is the claypan subsoil, which restricts the penetration of plant roots. The native vegetation dominantly is western wheatgrass, green needlegrass, and blue grama. Overused areas are dominated by blue grama, buffalograss, and saltgrass. If overuse continues, bare areas are common or weeds dominate the site.

These soils are poorly suited to cultivated crops and to tame pasture and hay. The dense claypan subsoil and the high content of sodium adversely affect crop growth by restricting root penetration and the rate of water intake. Tilling is difficult because the dense subsoil is near the surface. If the soils are cultivated when wet, they become cloddy. Leaving crop residue on the surface when the soils are tilled and including grasses and legumes in the cropping system improve tilth and fertility, increase the rate of water intake, and conserve moisture. The Cavour soil is suited to alfalfa, crested wheatgrass, intermediate wheatgrass, and pubescent wheatgrass for tame pasture and hay. No grass species grows well, however, on the Miranda soil.

These soils are poorly suited to windbreaks and environmental plantings. Carefully selected trees and shrubs can be established on the Cavour soil, but optimum survival, growth, and vigor are unlikely. No trees and shrubs grow well on the Miranda soil.

Because of the moderate or high shrink-swell potential, these soils are poorly suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. These soils are poorly suited to septic tank absorption fields because of the restricted permeability. These fields generally do not function well unless they are greatly expanded.

The Cavour soil is in capability subclass IVs, Claypan range site; the Miranda soil is in capability subclass VIs, Thin Claypan range site.

22A—Niobell-Miranda loams, 0 to 3 percent slopes. These deep, nearly level and gently undulating, moderately well drained soils are on uplands. The Niobell soil is on the higher parts of the landscape, and the Miranda soil is in microdepressions. The surface is uneven because of the many low spots. Areas are irregular in shape and 10 to 250 acres in size. They are 40 to 50 percent Niobell soil and 25 to 35 percent Miranda soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Niobell soil is dark grayish brown loam about 7 inches thick. Below this is a transitional layer of dark grayish brown and grayish brown loam about 6 inches thick. The subsoil is grayish brown, pale brown, and light brownish gray, firm clay loam about 18 inches thick. In the lower part it has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray and light yellowish brown, calcareous clay loam.

Typically, the surface layer of the Miranda soil is grayish brown loam about 2 inches thick. The subsoil is dark grayish brown and grayish brown clay loam about 16 inches thick. It has nests of gypsum in the lower part. It is firm in the upper part and friable in the lower part. The underlying material to a depth of 60 inches is light yellowish brown clay loam that has accumulations of

carbonate and nests of gypsum. In places the subsoil and underlying material contain more clay.

Included with these soils in mapping are small areas of Heil, Noonan, and Williams soils. These included soils make up less than 25 percent of any one mapped area. The poorly drained Heil soils are in depressions. Williams soils do not have a sodium affected subsoil. They are higher on the landscape than the Niobell and Miranda soils. Noonan soils do not have visible salt crystals within a depth of 16 inches. They are around the microdepressions and between areas of the Miranda and Niobell soils.

The content of organic matter is moderate in the Niobell and Miranda soils. Fertility is medium in the Niobell soil and low or medium in the Miranda soil. Both soils have a sodium affected subsoil that restricts root penetration. Tilth is poor. Permeability is slow in the Niobell soil and very slow in the Miranda soil. Available water capacity is moderate or high in the Niobell soil and moderate in the Miranda soil. Runoff is slow on both soils. The shrink-swell potential is high in the subsoil of the Niobell soil and moderate in the underlying material. It is moderate in the Miranda soil.

Most of the acreage supports native grasses and is used for grazing. The Niobell soil is well suited to range, but the Miranda soil is poorly suited. The claypan subsoil in the Miranda soil restricts the penetration of plant roots. As a result, stands of grasses are sparse on this soil. The native vegetation on the Niobell soil dominantly is western wheatgrass and green needlegrass. Overused areas are dominated by western wheatgrass, blue grama, and Kentucky bluegrass. The native vegetation on the Miranda soil dominantly is western wheatgrass and blue grama. Overused areas are dominated by a thin stand of blue grama, buffalograss, inland saltgrass, and sedges.

These soils are poorly suited to cultivated crops and to tame pasture and hay. They are better suited to tame pasture and hay and small grain than to row crops. Conserving moisture, increasing the rate of water intake, and improving tilth are the main concerns of management. Tillage practices that leave crop residue on the surface conserve moisture. Inclusion of grasses and legumes in the cropping system, timely tillage, and chiseling or subsoiling increase the rate of water intake and improve tilth and fertility. The Niobell soil is suited to alfalfa, intermediate wheatgrass, and pubescent wheatgrass for tame pasture and hay. No grass species grows well, however, on the Miranda soil (fig. 5).

Figure 5.—Sparse vegetation on the Miranda soil in an area of Niobell-Miranda loams, 0 to 3 percent slopes.

These soils are poorly suited to windbreaks and environmental plantings. The dense claypan subsoil and high content of sodium in the Miranda soil severely restrict the growth and survival of trees and shrubs. Most climatically suited trees and shrubs grow well on the Niobell soil. Field windbreaks can be planted on these soils, but their effectiveness is greatly reduced because of the severely restricted growth on the Miranda soil.

Because of the moderate or high shrink-swell potential, these soils are poorly suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. These soils are poorly suited to septic tank absorption fields because of the restricted permeability. These fields generally do not function well unless they are greatly expanded.

The Niobell soil is in capability subclass IIIs, Clayey range site; the Miranda soil is in capability subclass VIs, Thin Claypan range site.

23A—Noonan Variant loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on terraces. It is moderately deep over sandy and loamy alluvium and gravelly sand. Areas are irregular in shape and 5 to 80 acres in size. Slopes are smooth or concave.

Typically, the surface layer is dark gray and dark grayish brown loam about 9 inches thick. The subsurface layer is light brownish gray loam about 3 inches thick. The subsoil is about 14 inches thick. It is dark gray and grayish brown, firm clay loam over grayish brown sandy loam that has threads of salts. The upper 10 inches of underlying material is light brownish gray loamy fine sand that has threads of salts. The next 5 inches is light brownish gray sandy loam that has accumulations of carbonate. The lower part to a depth of 60 inches is multicolored gravelly sand that has many shale fragments. In some areas the subsoil does not have columnar structure. In other areas it contains less clay.

Included with this soil in mapping are small areas of Harriet, Ranslo, and Tally soils. These soils make up less than 15 percent of any one mapped area. The poorly drained Harriet and somewhat poorly drained Ranslo soils are lower on the landscape than the Noonan Variant soil. Tally soils contain less clay than the Noonan Variant soil and do not have columnar structure in the subsoil or gravelly underlying material. They are on the higher convex parts of the landscape.

The content of organic matter is moderate and fertility medium in the Noonan Variant soil. The sodium affected subsoil restricts root penetration. Permeability is slow in the subsoil and rapid in the underlying material. Available water capacity is moderate. Runoff is slow. The shrink-swell potential is high in the subsoil and low in the underlying material.

Most of the acreage is cropland. This soil is poorly suited to cultivated crops. It is better suited to early maturing small grain than to row crops. The claypan subsoil restricts the penetration of plant roots. The main concerns of management are conserving moisture and improving tilth. Leaving crop residue on the surface when the soil is tilled, chiseling or subsoiling, and including grasses and legumes in the cropping system conserve moisture and improve tilth and fertility.

This soil is fairly well suited to tame pasture and hay. The choice of pasture plants is limited because the dense claypan subsoil restricts the penetration of plant roots. Alfalfa, crested wheatgrass, intermediate wheatgrass, and pubescent wheatgrass are suitable.

This soil is fairly well suited to range. The native vegetation dominantly is western wheatgrass, green needlegrass, and blue grama. Overused areas are dominated by blue grama and weeds.

This soil is poorly suited to windbreaks and environmental plantings because of the dense, compact subsoil. Carefully selected trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soil is an improbable source of sand and gravel for use as road construction material because of the large amount of shale in the underlying material.

The capability subclass is IVs; Claypan range site.

24A—Niobell-Noonan loams, 1 to 5 percent slopes. These deep, nearly level to undulating, moderately well drained soils are on uplands. The Niobell soil is on the higher parts of the landscape, and the Noonan soil is on the lower parts. The surface is uneven because of many scattered low spots. Areas are irregular in shape and 15 to more than 400 acres in size. They are 45 to 50 percent Niobell soil and 30 to 40 percent Noonan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Niobell soil is dark grayish brown loam about 7 inches thick. Below this is a transitional layer of dark grayish brown and grayish brown loam about 6 inches thick. The subsoil is grayish brown, pale brown, and light brownish gray, firm clay loam about 18 inches thick. In the lower part it has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray and light yellowish brown, calcareous clay loam.

Typically, the surface layer of the Noonan soil is dark grayish brown loam about 6 inches thick. The subsurface layer is grayish brown loam about 3 inches thick. The subsoil is brown and grayish brown, firm and friable clay

loam about 19 inches thick. In the lower part it has nests and threads of gypsum and other salts that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam.

Included with these soils in mapping are small areas of Heil, Miranda, Tally, and Williams soils. These included soils make up less than 20 percent of any one mapped area. The poorly drained Heil soils are in depressions. Miranda soils have visible salts within a depth of 16 inches. They are on the lower parts of the landscape. Tally soils contain more sand throughout and less clay in the subsoil than the Noonan and Niobell soils. They are on broad ridges. Willaims soils do not have a sodium affected subsoil. They are higher on the landscape than the Niobell soil.

The content of organic matter is moderate and fertility medium in the Niobell and Noonan soils. Both soils have a sodium affected subsoil that restricts root penetration. Tilth is poor. Permeability is slow. Available water capacity is moderate or high in the Niobell soil and moderate in the Noonan soil. Runoff is medium on both soils. The shrink-swell potential is high in the subsoil and moderate in the underlying material.

Most of the acreage is cropland. The Niobell soil is fairly well suited to cultivated crops, but the Noonan soil is poorly suited. Both soils are better suited to small grain and to tame pasture and hay than to row crops (fig. 6). The claypan subsoil restricts the penetration of plant roots. Increasing the rate of water intake, improving tilth, and conserving moisture are the main concerns of management. Tillage practices that leave crop residue on the surface conserve moisture. Inclusion of grasses and legumes in the cropping system, timely tillage, and chiseling or subsoiling increase the rate of water intake and improve tilth and fertility. Alfalfa, intermediate wheatgrass, and pubescent wheatgrass are suitable for tame pasture and hay.

Figure 6.—An area of Niobell-Noonan loams, 1 to 5 percent slopes, used for tame hay.

The Niobell soil is well suited and the Noonan soil fairly well suited to range. The native vegetation dominantly is western wheatgrass, green needlegrass, and blue grama. Overused areas are dominated by western wheatgrass and blue grama. If overuse continues, bare areas are common or weeds dominate the site.

The Niobell soil is fairly well suited to windbreaks and environmental plantings, but the Noonan soil is poorly suited. The sodium affected subsoil in both soils severely limits tree growth. Carefully selected trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely.

Because of the moderate or high shrink-swell potential, these soils are only fairly well suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. These soils are poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The Niobell soil is in capability subclass IIIs, Clayey range site; the Noonan soil is in capability subclass IVs, Claypan range site.

25—Miranda-Heil complex. These deep, nearly level and level soils are in slight depressions in the uplands. The poorly drained Heil soil is slightly lower on the landscape than the somewhat poorly drained Miranda soil. It receives runoff, which ponds during snowmelt and heavy rainfall. Areas are irregular in shape and 10 to 100 acres in size. They are 50 to 60 percent Miranda soil and 25 to 35 percent Heil soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Miranda soil is grayish brown loam about 2 inches thick. The subsoil is firm clay loam about 11 inches thick. The upper part is dark grayish brown, the middle part is grayish brown, and the lower part is light brownish gray. The middle and lower parts are calcareous and have nests of salt. The underlying material to a depth of 60 inches is grayish brown and light brownish gray clay loam that has nests of salt and gypsum.

Typically, the surface layer of the Heil soil is gray silt loam about 2 inches thick. The subsoil is dark gray and gray, firm clay about 24 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is gray, calcareous silty clay and clay loam.

Included with these soils in mapping are small areas of Nishon, Niobell, and Noonan soils. These included soils make up less than 15 percent of any one mapped area. Nishon soils are on the edges of small depressions. Their surface layer is 1 to 4 inches thick. The moderately well drained Niobell and Noonan soils are on the slightly higher parts of the landscape.

The content of organic matter is moderate in the Miranda and Heil soils. Fertility is low or medium in the Miranda soil and medium in the Heil soil. Both soils have a dense, sodium affected subsoil that restricts root penetration. Permeability is very slow. Available water capacity is moderate. A seasonal high water table is as much as 1 foot above the surface of the Heil soil or as much as 1 foot below. Runoff is slow on the Miranda soil and ponded on the Heil soil. The shrink-swell potential is moderate in the Miranda soil and high in the Heil soil.

Most of the acreage supports native grasses and is used for grazing. The Heil soil is fairly well suited to range, but the Miranda soil is poorly suited. The native vegetation on the Miranda soil dominantly is blue grama and western wheatgrass. That on the Heil soil dominantly is western wheatgrass and sedges. Overused areas are dominated by inland saltgrass, buffalograss, and sedges.

These soils generally are unsuited to cultivated crops and to windbreaks and environmental plantings. The dense, compact, sodium affected subsoil in both soils and the ponding on the Heil soil are the main limitations.

These soils are poorly suited to tame pasture and hay. The Heil soil is better suited than the Miranda soil. If possible, only the Heil soil should be used for tame pasture. Garrison creeping foxtail and reed canarygrass are the best suited species.

Because of the moderate shrink-swell potential, the Miranda soil is poorly suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. The Heil soil generally is unsuited to building site development because of the ponding.

These soils are poorly suited to septic tank absorption fields. The restricted permeability is the main limitation. Also, the ponding on the Heil soil is a limitation.

The capability subclass is VIs; the Miranda soil is in Thin Claypan range site and the Heil soil in Closed Depression range site.

26—Cresbard-Cavour loams. These deep, moderately well drained, nearly level soils are on uplands. The Cresbard soil is on slight rises, and the Cavour soil is in microdepressions. Areas are irregular in shape and 25 to 300 acres in size. They are 45 to 55 percent Cresbard soil and 35 to 45 percent Cavour soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Cresbard soil is dark gray loam about 7 inches thick. The subsurface layer is grayish brown loam about 3 inches thick. Below this is a

transitional layer about 2 inches thick. It is dark grayish brown clay loam that has light brownish gray coatings of very fine sand. The subsoil is dark gray and grayish brown, firm clay loam about 14 inches thick. It has visible salt crystals in the lower part. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam that has visible crystals of salt and gypsum. In places the subsoil contains less clay.

Typically, the surface layer of the Cavour soil is dark gray, friable loam about 9 inches thick. The subsurface layer is gray loam about 2 inches thick. The subsoil is about 21 inches of firm clay and clay loam. The upper part is dark gray, and the lower part is olive gray and has visible salt crystals. The underlying material to a depth of 60 inches is light olive gray, calcareous clay loam that has accumulations of carbonate and visible crystals of salt and gypsum. In places the subsoil contains less clay.

Included with these soils in mapping are small areas of Heil and Miranda soils. These included soils make up less than 15 percent of any one mapped area. The poorly drained Heil soils are in depressions. Miranda soils have visible salts within a depth of 16 inches. They are in microdepressions.

The content of organic matter is moderate and fertility medium in the Cresbard and Cavour soils. Both soils have a sodium affected subsoil that restricts root penetration. Permeability is moderately slow or slow in the Cresbard soil. It is slow or very slow in the subsoil of the Cavour soil and slow or moderately slow in the underlying material. Available water capacity is moderate in both soils. Runoff is slow. The shrink-swell potential is high in the subsoil and moderate in the underlying material.

Most of the acreage is cropland. The Cresbard soil is fairly well suited to cultivated crops, but the Cavour soil is poorly suited. The dense, compact subsoil and the soluble salts in the subsoil of both soils adversely affect crop production by restricting root penetration. Tilling is difficult because of the dense claypan subsoil. If the soils are tilled when wet, they become cloddy. Measures that increase the rate of water intake, improve tilth, and conserve moisture are the main management needs. Examples are leaving crop residue on the surface when the soils are tilled and including grasses and legumes in the cropping system. Chiseling and subsoiling help to break up the dense claypan subsoil and thus increase the rate of water intake.

The Cresbard soil is well suited and the Cavour soil fairly well suited to range. The native vegetation dominantly is western wheatgrass, blue grama, and green needlegrass. Overused areas normally are dominated by western wheatgrass and blue grama. During wet cycles they are dominated by blue grama and weeds.

The Cresbard soil is well suited and the Cavour soil fairly well suited to tame pasture and hay. The dense, compact subsoil in the Cavour soil limits the choice of pasture plants and productivity. Alfalfa, intermediate wheatgrass, pubescent wheatgrass, and smooth bromegrass are suitable.

The Cresbard soil is fairly well suited to windbreaks and environmental plantings, but the Cavour soil is poorly suited. No trees and shrubs grow well on the Cavour soil because the dense subsoil severely limits root penetration. Carefully selected trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely.

Because of the high shrink-swell potential, these soils are poorly suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. These soils are poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste.

The Cresbard soil is in capability subclass IIIs, Clayey range site; the Cavour soil is in capability subclass IVs, Claypan range site.

27B—Lehr-Bowdle loams, 0 to 6 percent slopes. These level to undulating soils are on outwash plains and terraces. The somewhat excessively drained Lehr soil is on the upper parts of ridges and knolls. It is shallow over gravelly sand. The well drained Bowdle soil is on the lower side slopes and in swales. It is moderately deep over gravelly sand. Areas are irregular in shape and 10 to 500 acres in size. They are 50 to 60 percent Lehr soil and 35 to 40 percent Bowdle soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Lehr soil is dark grayish brown loam about 5 inches thick. The subsoil is brown, friable loam about 10 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sand.

Typically, the surface layer of the Bowdle soil is dark grayish brown loam about 7 inches thick. The subsoil is dark grayish brown, friable loam about 15 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sandy loam and gravelly sand. In places the soil is dark to a depth of less than 16 inches.

Included with these soils in mapping are small areas of Wabek soils on the higher convex parts of the landscape. These included soils make up less than 10 percent of any one mapped area. They are shallower to gravelly sand than the Lehr and Bowdle soils.

The content of organic matter and fertility are high in the Bowdle soil. The content of organic matter is moderate and fertility medium in the Lehr soil. Permeability is moderately rapid in the subsoil of the Lehr soil and rapid or very rapid in the underlying

gravelly sand. It is moderate in the subsoil of the Bowdle soil and rapid in the underlying gravelly sand. Available water capacity is low in the Lehr soil and low or moderate in the Bowdle soil. Runoff is slow on both soils.

Most of the acreage is cropland. The Bowdle soil is fairly well suited to cultivated crops, but the Lehr soil is poorly suited. Because the porous underlying material restricts root penetration, both soils are better suited to early maturing small grain than to row crops. Measures that control erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface.

These soils are poorly suited to tame pasture and hay. The main limitations are the low available water capacity and shallow root zone in the Lehr soil. Crested wheatgrass is a suitable species.

The Bowdle soil is well suited to range, but the Lehr soil is poorly suited. The shallow root zone and low available water capacity in the Lehr soil limit productivity. The native vegetation on the Lehr soil dominantly is needleandthread and grama grasses. That on the Bowdle soil dominantly is green needlegrass, western wheatgrass, and needleandthread. Overused areas are dominated by western wheatgrass, needleandthread, and blue grama. Also, weeds increase in extent on the Lehr soil.

These soils are poorly suited to windbreaks and environmental plantings because they are droughty. No trees and shrubs grow well. Drought resistant species can be established, but optimum survival, growth, and vigor are unlikely.

These soils are well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soils readily absorb the effluent from septic tank absorption fields, but they do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. These soils are a probable source of sand and gravel for road construction.

The Lehr soil is in capability subclass IVe, Shallow to Gravel range site; the Bowdle soil is in capability subclass IIIe, Silty range site.

29—Exline-Harmony complex. These deep, nearly level soils are on lake plains. The somewhat poorly drained Exline soil is in microdepressions. The moderately well drained Harmony soil is adjacent to the microdepressions. Areas are irregular in shape and 10 to 160 acres in size. They are 50 to 60 percent Exline soil and 30 to 40 percent Harmony soil. The two soils occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the surface layer of the Exline soil is gray silt loam about 2 inches thick. The subsoil is dark gray, gray, and grayish brown, very firm silty clay about 17 inches thick. In the lower part it is calcareous and has accumulations of carbonate, salt, and gypsum that extend into the underlying material. The underlying material to a depth of 60 inches is light olive gray, olive gray, and light brownish gray, calcareous silty clay, silty clay loam, and clay loam. In places, the surface layer and the subsoil are thicker and the content of visible salt crystals is lower.

Typically, the surface layer of the Harmony soil is dark gray silty clay loam about 8 inches thick. The subsoil is about 15 inches thick. It is dark gray, firm silty clay over grayish brown, friable, calcareous silty clay loam. The underlying material to a depth of 60 inches is calcareous, light brownish gray silty clay loam that has accumulations of carbonate and nests of gypsum and other salts. In places the subsoil contains less clay.

Included with these soils in mapping are small areas of Cavour and Miranda soils. These included soils make up less than 10 percent of any one mapped area. The Cavour soils have a sodium affected subsoil. They are in positions on the landscape similar to those of the Harmony soil. The Miranda soils contain more sand throughout and less clay in the subsoil than the Exline soil. They are in positions on the landscape similar to those of the Exline soil.

The content of organic matter is moderate and fertility low in the Exline soil. The content of organic matter and fertility are high in the Harmony soil. The Exline soil has a sodium affected subsoil that restricts root penetration. Tilth is poor in both soils. Permeability is very slow in the Exline soil and moderately slow in the Harmony soil. Available water capacity is moderate or low in the Exline soil and high in the Harmony soil. The Exline soil has a seasonal water table at a depth of 2.5 to 4.0 feet during wet periods. Runoff is very slow on the Exline soil and slow on the Harmony soil. The shrink-swell potential is high in the upper part of both soils and moderate in the lower part.

Most of the acreage is cropland. The Exline soil generally is unsuited to cultivated crops and to tame pasture and hay because the dense, compact subsoil and high content of salts restrict root penetration and the availability of plant nutrients. The Harmony soil is well suited to cultivated crops, but it generally cannot be cropped because it occurs as areas too closely intermingled with areas of the Exline soil. Crop growth is uneven because it is severely restricted on the Exline soil. Improving tilth and conserving moisture are the main concerns of management. Leaving crop residue on the surface when the soils are tilled, chiseling or subsoiling, and including grasses and legumes in the cropping system improve tilth and fertility and conserve moisture. Alfalfa, intermediate wheatgrass, and pubescent wheatgrass are the best grasses for tame pasture and hay. Optimum production, however, is unlikely.

These soils are poorly suited to range. Native grass production is limited by the dense, compact subsoil and high content of salts in the Exline soil. The grass stand is thin on this soil. The native vegetation on the Exline soil dominantly is western wheatgrass and blue grama.

That on the Harmony soil dominantly is western wheatgrass, green needlegrass, and lesser amounts of bluestems. Overused areas are dominated by western wheatgrass, blue grama, and other short grasses.

These soils generally are unsuited to windbreaks and environmental plantings. Trees and shrubs grow well on the Harmony soil. The dense, compact subsoil and the high content of salts in the Exline soil, however, restrict root penetration, the available water capacity, and the availability of plant nutrients.

The Harmony soil is only fairly well suited to most kinds of building site development because of the high shrink-swell potential. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. The Exline soil is poorly suited to building site development and septic tank absorption fields because of the wetness. The Harmony soil is poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste.

The Exline soil is in capability subclass VIs, Thin Claypan range site; the Harmony soil is in capability subclass IIs, Clayey range site.

30—Letcher-Parshall loams, 0 to 4 percent slopes. These deep, nearly level to undulating soils occur as small areas of outwash on uplands. The moderately well drained Letcher soil is in low, smooth to slightly hummocky areas. The well drained Parshall soil is in convex areas above the Letcher soil. Areas are irregular in shape and 20 to 320 acres in size. They are 35 to 45 percent Letcher soil and 30 to 40 percent Parshall soil. The two soils occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the surface layer of the Letcher soil is about 15 inches thick. The upper part is dark gray loam, and the lower part is gray fine sandy loam. The subsurface layer is light brownish gray fine sandy loam about 4 inches thick. The subsoil is sodium affected. It is grayish brown, friable and very friable sandy loam about 14 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is grayish brown and light brownish gray, calcareous sandy loam, loam, and clay loam.

Typically, the surface layer of the Parshall soil is dark grayish brown loam about 9 inches thick. The subsurface layer is grayish brown fine sandy loam about 7 inches thick. The subsoil is brown, friable fine sandy loam about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous fine sandy loam over calcareous loamy fine sand that has accumulations of carbonate. In some areas gravelly sand is below a depth of 40 inches. In places a buried surface layer is in the underlying material.

Included with these soils in mapping are small areas of Miranda, Niobell, Stirum, Tally, and Williams soils. These included soils make up less than 25 percent of any one mapped area. Miranda and Niobell soils contain more clay in the subsoil than the Letcher soil and are higher on the landscape than the Letcher and Parshall soils. Also, Miranda soils have visible salt crystals within a depth of 16 inches. The poorly drained Stirum soils are in depressions. Tally and Williams soils are on knolls or slight rises. They do not have a sodium affected subsoil. Tally soils are not dark below a depth of 16 inches. Williams soils contain more clay in the subsoil than the Letcher and Parshall soils.

The content of organic matter is moderate and fertility medium in the Letcher and Parshall soils. The Letcher soil has a sodium affected subsoil that restricts root penetration. Permeability is slow in the subsoil of the Letcher soil and slow to moderately rapid in the underlying material. It is moderately rapid in the Parshall soil. Available water capacity is low or moderate in the Letcher soil and moderate in the Parshall soil. Runoff is slow on both soils. The Letcher soil has a water table at a depth of 3.5 to 6.0 feet during wet periods. It has a moderate shrink-swell potential in the lower part of the underlying material.

Most of the acreage is range. The native vegetation dominantly is little bluestem, prairie sandreed, needleandthread, and western wheatgrass. Overused areas are dominated by prairie sandreed, needleandthread, western wheatgrass, and sideoats grama. After continued overuse, Kentucky bluegrass and blue grama dominate the site.

The Letcher soil is poorly suited and the Parshall soil fairly well suited to cultivated crops. These soils are better suited to small grain and alfalfa than to row crops. The subsoil of the Letcher soil takes in water slowly and releases it slowly to plants. Also, the sodium and other salts in the subsoil and underlying material of this soil restrict crop growth. Measures that control wind erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface and stripcropping. Including grasses and legumes in the cropping system also helps to control wind erosion.

These soils are well suited to tame pasture and hay (fig. 7). Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable.

The Parshall soil is well suited to windbreaks and environmental plantings, but the Letcher soil is poorly suited. Tree growth is restricted by the sodium affected subsoil in the Letcher soil. All climatically suited trees and shrubs grow well on the Parshall soil. Preparing the site in the spring helps to control wind erosion.

The Letcher soil is suitable as a site for most buildings but is only fairly well suited to buildings with basements because of the moderate shrink-swell potential and the wetness. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the

buildings help to prevent the damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. The Parshall soil is well suited to building site development, but the sides of shallow excavations tend to cave in unless they are shored. The Parshall soil is well suited to septic tank absorption fields, but the Letcher soil generally is unsuited because of the wetness and the restricted permeability.

The Letcher soil is in capability subclass IVe, Sandy range site; the Parshall soil is in capability subclass IIIe, Sandy range site.

31—Harmony silty clay loam. This deep, moderately well drained, nearly level soil is on lake plains. Areas are irregular in shape and 10 to about 115 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark gray silty clay loam about 8 inches thick. The subsoil is about 15 inches thick. It is dark gray, firm silty clay over grayish brown, friable, calcareous silty clay loam. The underlying material to a depth of 60 inches is light brownish gray, calcareous silty clay loam that has accumulations of carbonate and nests of gypsum and other salts.

Included with this soil in mapping are small areas of Arnegard, Bearden, Exline, and Rentill soils. These soils make up less than 15 percent of any one mapped area. Exline soils have a sodium affected subsoil. They are slightly lower on the landscape than the Harmony soil. Arnegard and Rentill soils contain more sand and less clay in the subsoil than the Harmony soil. Also, they are slightly higher on the landscape. The somewhat poorly drained Bearden soils are in slight depressions.

The content of organic matter and fertility are high in the Harmony soil. Tilth is poor. Permeability is moderately slow. Available water capacity is high. Runoff is slow. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Measures that improve tilth and conserve moisture are the main management needs. Examples are leaving crop residue on the surface when the soil is tilled and including grasses and legumes in the cropping system.

This soil is well suited to range. The native vegetation dominantly is western wheatgrass, green needlegrass, and lesser amounts of bluestem. Overused areas are dominated by western wheatgrass and short grasses.

This soil is fairly well suited to windbreaks and environmental plantings. The clayey subsoil can restrict the penetration of tree roots. All climatically suited trees and shrubs grow well, except for those that require an abundant supply of moisture.

Because of the high shrink-swell potential, this soil is only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. The soil is poorly suited to septic tank absorption fields because of

Figure 7.—An area of Letcher-Parshall loams, 0 to 4 percent slopes, used for tame pasture.

the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste.

The capability subclass is IIs; Clayey range site.

32—Harmony-Exline complex. These deep, nearly level soils are on lake plains. The moderately well drained Harmony soil is on the higher parts of the landscape. The somewhat poorly drained Exline soil is in microdepressions. Areas are irregular in shape and 15 to 400 acres in size. They are 50 to 60 percent Harmony soil and 20 to 30 percent Exline soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Harmony soil is dark gray silty clay loam about 8 inches thick. The subsoil is about 15 inches thick. It is dark gray, firm silty clay over grayish brown, friable, calcareous silty clay loam. The underlying material to a depth of 60 inches is light brownish gray, calcareous silty clay loam that has accumulations of carbonate and nests of gypsum and other salts. In places the subsoil contains less clay.

Typically, the surface layer of the Exline soil is gray silt loam about 2 inches thick. The subsoil is dark gray, gray, and grayish brown, very firm silty clay about 17 inches thick. In the lower part it is calcareous and has accumulations of carbonate, salts, and gypsum that extend into the underlying material. The underlying material to a depth of 60 inches is light olive gray, olive gray, and light brownish gray, calcareous silty clay, silty clay loam, and clay loam. In places the surface layer and the subsoil are thicker and the content of visible salt crystals is lower.

Included with these soils in mapping are small areas of Arnegard and Rentill soils. These included soils make up less than 15 percent of any one mapped area. They are slightly higher on the landscape than the Exline and Harmony soils. Arnegard soils contain more sand throughout and less clay in the subsoil than the Harmony soil. Rentill soils contain more sand throughout and less clay in the upper part than the Harmony soil.

The content of organic matter and fertility are high in the Harmony soil. The content of organic matter is moderate and fertility low in the Exline soil. The Exline soil has a sodium affected subsoil that restricts root penetration. Tilth is fair in the Harmony soil and poor in the Exline soil. Permeability is moderately slow in the Harmony soil and very slow in the Exline soil. Available water capacity is high in the Harmony soil and low or moderate in the Exline soil. A seasonal water table is at a depth of 2.5 to 4.0 feet in the Exline soil during wet periods. Runoff is slow on the Harmony soil and very slow on the Exline soil. The shrink-swell potential is high in the upper part of both soils and moderate in the lower part.

Most of the acreage is cropland. The Harmony soil is well suited to cultivated crops and to tame pasture and hay. The Exline soil generally is unsuited, however, because the dense, compact subsoil and high content of salts restrict root penetration and the availability of plant nutrients. Crop growth is uneven because it is severely restricted on the Exline soil. Measures that improve tilth and conserve moisture are the main management needs. Examples are leaving crop residue on the surface when the soils are tilled, chiseling or subsoiling, and including grasses and legumes in the cropping system. Alfalfa, intermediate wheatgrass, and pubescent wheatgrass are the best grasses for tame pasture and hay. Optimum production is unlikely, however, on the Exline soil.

These soils are suited to range. The native vegetation on the Harmony soil dominantly is western wheatgrass, green needlegrass, and lesser amounts of bluestems. That on the Exline soil dominantly is western wheatgrass and blue grama. Overused areas are dominated by western wheatgrass, blue grama, and buffalograss. Saltgrass increases in extent if the Exline soil is overused.

The Harmony soil is only fairly well suited to windbreaks and environmental plantings because the clayey subsoil restricts root penetration. All climatically suited trees and shrubs grow well, except for those that require an abundant supply of moisture. The Exline soil generally is unsuited to trees and shrubs because the dense, compact subsoil and the high content of salts severely restrict root penetration. Optimum growth and survival are unlikely.

The Harmony soil is better than the Exline soil as a site for buildings because of the wetness in the Exline soil. Because of the high shrink-swell potential, however, it is only fairly well suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

The Harmony soil is poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area in these fields, however, helps to overcome the slow absorption of liquid waste. The Exline soil generally is unsuited to septic tank absorption fields because of the wetness and the restricted permeability.

The Harmony soil is in capability subclass IIs, Clayey range site; the Exline soil is in capability subclass VIs, Thin Claypan range site.

37—Straw loam, channeled. This deep, moderately well drained, nearly level soil is on flood plains that are dissected by stream channels. It is frequently flooded for brief periods. Areas are long and narrow and 20 to 300 acres in size.

Typically, the surface layer is very dark gray, calcareous loam about 5 inches thick. The subsurface layer is dark gray loam about 10 inches thick. The upper 7 inches of underlying material is grayish brown, calcareous, stratified loam, fine sandy loam, and silt

loam. The next 11 inches is dark grayish brown loam. The next 7 inches is calcareous, light brownish gray sandy loam. The lower part to a depth of 60 inches is grayish brown, calcareous, stratified loam and loamy sand. In some areas the soil is not calcareous in the upper part. In other areas it is more poorly drained.

Included with this soil in mapping are small areas of Divide, Harriet, Lehr, and Ranslo soils. These soils make up less than 15 percent of any one mapped area. Divide soils contain more carbonates within a depth of 16 inches than the Straw soil and have gravelly sand at a depth of 20 to 36 inches. They occur as areas intermingled with some areas of the Straw soil. Harriet and Ranslo soils contain more clay than the Straw soil and have salts in the subsoil. They occur as areas intermingled with some areas of the Straw soil. Lehr soils have gravelly sand within a depth of 20 inches. They are on the higher parts of the landscape.

The content of organic matter and fertility are high in the Straw soil. Permeability and available water capacity are moderate. A water table is at a depth of 3 to 6 feet during wet periods. Runoff is slow.

Most of the acreage supports native grasses and is used for grazing. This soil is well suited to range. The native vegetation dominantly is big bluestem and lesser amounts of western wheatgrass and green needlegrass. Overused areas are dominated by western wheatgrass and Kentucky bluegrass.

Because of the meandering channels and the flooding, this soil is poorly suited to cultivated crops. Areas that are accessible to farm machinery are well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well. Silt and debris deposited by floodwater in some years damage pasture plants and hinder haying.

This soil generally is unsuited to windbreaks and environmental plantings. Trees and shrubs can be planted for special purposes on selected sites.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the flooding.

The capability subclass is VIw; Overflow range site.

38—Regan silt loam. This deep, poorly drained, level soil is on flood plains along glacial melt water channels and in depressions in glacial lake plains. It is occasionally flooded for long periods. Areas are 20 to 220 acres in size. Most are irregular in shape, but some are long and narrow.

Typically, the surface layer is dark gray, calcareous silt loam about 8 inches thick. Below this is a transitional layer of gray, calcareous silt loam about 15 inches thick. The underlying material to a depth of 60 inches is calcareous, light gray and gray silt loam and silty clay loam. In places visible salt crystals are in the upper part of the soil.

Included with this soil in mapping are small areas of Bearden, Lehr, and Ranslo soils. These soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Bearden soils are slightly higher on the landscape than the Regan soil. Lehr soils have gravelly sand within a depth of 20 inches. They are on high terraces. Ranslo soils have a sodium affected subsoil. They are near the outer edge of the mapped areas.

The content of organic matter is high and fertility medium in the Regan soil. Permeability is moderately slow or moderate. Available water capacity is high. A water table is within a depth of 1 foot during wet periods. Runoff is very slow.

Most of the acreage supports native grasses and is used for grazing. This soil is well suited to range. The tall prairie grasses are highly productive because they benefit from the high water table. The native vegetation dominantly is big bluestem, switchgrass, and indiangrass. Overused areas are dominated by inland saltgrass, Kentucky bluegrass, and western wheatgrass.

This soil is poorly suited to cultivated crops because the wetness delays tillage in the spring and during other wet periods. Artificial drainage generally is not feasible. The high content of lime in the surface layer adversely affects the availability of plant nutrients. The main concerns of management are removing the excess water and controlling wind erosion. Tillage practices that leave crop residue on the surface and cover crops help to control wind erosion.

This soil is fairly well suited to tame pasture and hay, but the choice of tame pasture plants is limited mainly to water tolerant species. Examples are Garrison creeping foxtail and reed canarygrass.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil generally is unsuited to building site development and sanitary facilities because of the wetness and the flooding.

The capability subclass is IVw; Subirrigated range site.

40A—Mondamin silty clay loam, 0 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on uplands. Areas are irregular in shape and 20 to 200 acres in size. Slopes are smooth or slightly convex.

Typically, the surface layer is dark gray silty clay loam about 5 inches thick. The subsoil is about 30 inches of dark gray, grayish brown, and light brownish gray, firm silty clay loam and silty clay. In the lower part it has accumulations of carbonate. The underlying material to a depth of 60 inches is light brownish gray, calcareous silty clay loam. In places the subsoil contains less clay.

Included with this soil in mapping are small areas of Grail, Nishon, and Tonka soils. These soils make up less than 15 percent of any one mapped area. Grail soils are dark to a depth of more than 16 inches. They are in swales. The poorly drained Nishon and Tonka soils are in shallow depressions.

The content of organic matter is high and fertility medium or high in the Mondamin soil. Tilth is fair.

Permeability is moderately slow or slow. Available water capacity is high. A water table is at a depth of 5 to 6 feet during wet periods. Runoff is slow. The shrink-swell potential is high in the subsoil.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Conserving moisture and improving tilth are the main concerns of management. Tillage practices that leave crop residue on the surface, timely tillage, and chiseling or subsoiling increase the rate of water intake, conserve moisture, and improve tilth.

This soil is well suited to range. The native vegetation dominantly is western wheatgrass and green needlegrass. Overused areas are dominated by western wheatgrass and short grasses.

This soil is only fairly well suited to windbreaks and environmental plantings. It takes in water slowly, and the clayey subsoil can restrict the penetration of plant roots.

Because of the high shrink-swell potential, this soil is poorly suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The capability subclass is IIs; Clayey range site.

40B—Mondamin silty clay loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. Areas are irregular in shape and 10 to 100 acres in size. Slopes are smooth or convex.

Typically, the surface layer is dark gray silty clay loam about 5 inches thick. The subsoil is about 30 inches of dark gray, grayish brown, and light brownish gray, firm silty clay loam and silty clay. In the lower part it has accumulations of carbonate. The underlying material to a depth of 60 inches is light brownish gray, calcareous silty clay loam. In places the subsoil contains less clay.

Included with this soil in mapping are small areas of Grail, Nishon, and Tonka soils. These soils make up less than 15 percent of any one mapped area. Grail soils are dark to a depth of more than 16 inches. They are in swales. The poorly drained Nishon and Tonka soils are in shallow depressions.

The content of organic matter is high and fertility medium or high in the Mondamin soil. Tilth is fair. Permeability is moderately slow or slow. Available water capacity is high. A water table is at a depth of 5 to 6 feet during wet periods. Runoff is medium. The shrink-swell potential is high in the subsoil.

Most of the acreage is cropland. This soil is fairly well suited to cultivated crops and to tame pasture and hay. Controlling erosion, conserving moisture, increasing the rate of water intake, and improving tilth are the main concerns of management. Tillage practices that leave crop residue on the surface help to control erosion and conserve moisture. Inclusion of grasses and legumes in the cropping system, timely tillage, and chiseling or subsoiling increase the rate of water intake and improve tilth and fertility.

This soil is well suited to range. The native vegetation dominantly is western wheatgrass and green needlegrass. Overused areas are dominated by western wheatgrass and short grasses.

This soil is only fairly well suited to windbreaks and environmental plantings. It takes in water slowly, and the clayey subsoil can restrict the penetration of plant roots.

Because of the high shrink-swell potential, this soil is poorly suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste.

The capability subclass is IIIe; Clayey range site.

43C—Wabek-Bowdle complex, 3 to 15 percent slopes. These undulating to rolling soils are on outwash plains and terraces. The excessively drained Wabek soil is on the crest of ridges and knolls. It is shallow over gravelly sand. Scattered stones are on the surface in some areas. The well drained Bowdle soil is on lower side slopes and in swales. It is moderately deep over gravelly sand. Areas are irregular in shape and 10 to 120 acres in size. They are 45 to 55 percent Wabek soil and 35 to 45 percent Bowdle soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Wabek soil is dark grayish brown gravelly loam about 6 inches thick. The upper 3 inches of the underlying material is dark grayish brown, calcareous gravelly sandy loam. The lower part to a depth of 60 inches is calcareous, multicolored gravelly sand.

Typically, the surface layer of the Bowdle soil is dark grayish brown loam about 7 inches thick. The subsoil is dark grayish brown, friable loam about 15 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sandy loam and gravelly sand. In places the soil is dark to a depth of less than 16 inches.

Included with these soils in mapping are small areas of Lehr and Williams soils. These included soils make up less than 10 percent of any one mapped area. Lehr soils have gravelly sand at a depth of 14 to 20 inches. They are on side slopes. Williams soils formed in glacial till. They are on the lower parts of the landscape.

The content of organic matter is moderate or low in the Wabek soil. Fertility is low. The content of organic

matter and fertility are high in the Bowdle soil. Permeability is very rapid in the Wabek soil. It is moderate in the subsoil of the Bowdle soil and rapid in the underlying gravelly sand. Available water capacity is low in the Wabek soil and low or moderate in the Bowdle soil. Runoff is slow on both soils.

Most of the acreage is cropland. The Wabek soil generally is unsuited to cultivated crops and to tame pasture and hay because it is shallow to gravelly sand and has low available water capacity. The Bowdle soil is fairly well suited, but the porous underlying material restricts root penetration.

These soils are poorly suited to range. The native vegetation on the Wabek soil dominantly is needleandthread, blue grama, and threadleaf sedge. Overused areas are dominated by thin stands of blue and hairy grama, threadleaf sedge, and weeds. The native vegetation on the Bowdle soil dominantly is green needlegrass, western wheatgrass, and needleandthread. Overused areas are dominated by western wheatgrass and needleandthread.

These soils generally are unsuited to windbreaks and environmental plantings. Trees and shrubs can be established on the Bowdle soil, but optimum survival and growth rates are unlikely.

These soils are only fairly well suited to building site development because of the slope. Land leveling is needed in some of the more sloping areas. The sides of shallow excavations tend to cave in unless they are shored. The soils are poorly suited to most sanitary facilities. They readily absorb the effluent from septic tank absorption fields, but they do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soils are a probable source of sand and gravel for road construction.

The Wabek soil is in capability subclass VIs, Very Shallow range site; the Bowdle soil is in capability subclass IIIe, Silty range site.

44D—Wabek gravelly loam, 6 to 20 percent slopes. This excessively drained, gently rolling to hilly soil is on ridges and hills on outwash plains and terraces. It is very shallow or shallow over gravelly sand. Scattered stones are on some of the higher hills and ridges. Areas are 5 to 250 acres in size. Most are long and narrow, but some are irregular in shape. Slopes are short and convex.

Typically, the surface layer is dark grayish brown gravelly loam about 6 inches thick. The upper 3 inches of the underlying material is dark grayish brown, calcareous gravelly sandy loam. The lower part to a depth of 60 inches is multicolored, calcareous gravelly sand.

Included with this soil in mapping are small areas of Bowdle and Lehr soils. These soils make up less than 15 percent of any one mapped area. They are deeper to gravelly sand than the Wabek soil. Lehr soils are on the middle parts of the landscape, and Bowdle soils are on the lower parts.

The content of organic matter is moderate or low and fertility low in the Wabek soil. Permeability is very rapid. Available water capacity is low. Runoff is slow.

Most of the acreage supports native grasses and is used for grazing. This soil is poorly suited to range. The native vegetation dominantly is needleandthread, blue grama, and threadleaf sedge. Overused areas are dominated by blue and hairy grama, threadleaf sedge, and weeds. After continued overuse, bare areas are common and erosion is a serious problem.

This soil generally is unsuited to cultivated crops, windbreaks and environmental plantings, and tame pasture and hay. The shallow root zone and the low available water capacity are the main limitations.

Because of the slope, this soil is only fairly well suited to building site development. Land leveling is needed in some areas. The sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soil is a probable source of sand and gravel for road construction.

The capability subclass is VIs; Very Shallow range site.

45B—Wabek-Lehr complex, 2 to 9 percent slopes. These gently undulating to gently rolling soils are on outwash plains and terraces. They are shallow to gravel. The excessively drained Wabek soil is on the upper convex parts of the landscape. A few small stones are on some of the ridges. The somewhat excessively drained Lehr soil is on the middle and lower side slopes. Areas are irregular in shape and 5 to 100 acres in size. They are 45 to 55 percent Wabek soil and 25 to 35 percent Lehr soil. The two soils occur as areas so closely intermingled that mapping them separately is not practical.

Typically, the surface layer of the Wabek soil is dark grayish brown gravelly loam about 6 inches thick. The upper 3 inches of underlying material is dark grayish brown, calcareous gravelly sandy loam. The lower part to a depth of 60 inches is multicolored, calcareous gravelly sand.

Typically, the surface layer of the Lehr soil is dark grayish brown loam about 5 inches thick. The subsoil is brown loam about 10 inches thick. The underlying material to a depth of 60 inches is calcareous, multicolored gravelly sand. In places the gravelly sand is at a depth of more than 20 inches.

Included with these soils in mapping are small areas of Bowdle and Williams soils. These included soils make up less than 20 percent of any one mapped area. Bowdle soils are 20 to 40 inches deep over gravelly sand. They are in swales. Williams soils formed in glacial till. They are adjacent to glacial till uplands.

The content of organic matter is moderate in the Lehr and Wabek soils. Fertility is low in the Wabek soil and medium in the Lehr soil. Permeability is very rapid in the

Wabek soil. It is moderately rapid in the subsoil of the Lehr soil and rapid or very rapid in the underlying gravelly sand. Available water capacity is low in both soils. Runoff is slow.

Most of the acreage supports native grasses and is used for grazing. These soils are best suited to range. The native vegetation dominantly is needleandthread, blue grama, and threadleaf sedge. Overused areas are dominated by blue grama, threadleaf sedge, and weeds.

The Wabek soil generally is unsuited to cultivated crops and to tame pasture and hay because it is shallow to gravelly sand and has low available water capacity. The Lehr soil is poorly suited because of the low available water capacity and the porous underlying material, which restricts root penetration.

These soils generally are unsuited to windbreaks and environmental plantings. Trees and shrubs can be established on the Lehr soil, but optimum survival and growth rates are unlikely.

These soils are well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soils readily absorb the effluent from septic tank absorption fields, but they do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water.

The Wabek soil is in capability subclass VIs, Very Shallow range site; the Lehr soil is in capability subclass IVe, Shallow to Gravel range site.

52B—Lihen-Parshall fine sandy loams, 0 to 6 percent slopes. These deep, well drained, nearly level to undulating soils are on uplands. The Lihen soil is on knolls and side slopes. The Parshall soil is on toe slopes and in swales. Slopes are smooth and convex. Areas are 10 to 100 acres in size and are irregular in shape. They are 50 to 60 percent Lihen soil and 25 to 35 percent Parshall soil. The soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Lihen soil is dark grayish brown fine sandy loam about 15 inches thick. The next 6 inches is grayish brown fine sand. The underlying material to a depth of 60 inches is pale brown fine sand.

Typically, the surface layer of the Parshall soil is dark gray fine sandy loam about 8 inches thick. The subsoil is dark gray fine sandy loam about 11 inches thick. The upper part of the underlying material is dark grayish brown fine sandy loam. The lower part to a depth of 60 inches is grayish brown loamy sand.

Included with these soils in mapping are small areas of Lehr and Williams soils. These included soils make up less than 20 percent of any one mapped area. They are in positions on the landscape similar to those of the Lihen soil. Lehr soils have gravelly sand within a depth of 20 inches. Williams soils contain more clay throughout than the Lihen and Parshall soils.

The content of organic matter is low or moderate in the Lihen soil and moderate in the Parshall soil. Fertility is medium in both soils. Permeability is rapid in the Lihen soil and moderately rapid in the Parshall soil. Available water capacity is low in the Lihen soil and moderate in the Parshall soil. Runoff is slow on both soils.

Most of the acreage is cropland. These soils are only fairly well suited to cultivated crops. The major concern of management is controlling wind erosion. Droughtiness also is a concern on the Lihen soil. Tillage practices that leave crop residue on the surface, field windbreaks, stripcropping, and inclusion of grasses and legumes in the cropping system help to control wind erosion and conserve moisture.

A cover of tame pasture plants or hay is effective in controlling wind erosion. A mulch of crop residue helps to control wind erosion until the pasture plants are established. Suitable species are alfalfa, intermediate wheatgrass, and smooth bromegrass.

These soils are well suited to range. The native vegetation dominantly is needleandthread and prairie sandreed. Bluestems, blue grama, and western wheatgrass are less extensive. Overused areas are dominated by prairie sandreed, blue grama, needleandthread, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. Only evergreens grow well, however, on the Lihen soil. All climatically suited trees and shrubs grow well on the Parshall soil. Planting after minimum site preparation helps to control wind erosion.

These soils are well suited to building site development, but the sides of shallow excavations tend to cave in unless they are shored. Both soils readily absorb the effluent from septic tank absorption fields, but the Lihen soil does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water.

The Lihen soil is in capability subclass IVe, the Parshall soil in capability subclass IIIe; both soils are in Sandy range site.

52D—Lihen loamy fine sand, 6 to 20 percent slopes. This deep, well drained, moderately sloping to moderately steep soil is on convex ridgetops, knolls, and short side slopes in the uplands. Areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 15 inches thick. The next 6 inches is grayish brown fine sand. The underlying material to a depth of 60 inches is pale brown fine sand.

Included with this soil in mapping are small areas of Parshall, Tally, and Wabek soils. These soils make up less than 15 percent of any one mapped area. Parshall and Tally soils contain less sand in the subsoil than the Lihen soil. Also, Parshall soils are dark to a depth of more than 16 inches. They are on the lower parts of the landscape. Tally soils occur as areas intermingled with areas of the Lihen soil. Wabek soils are on ridgetops. They have gravelly sand within a depth of 14 inches.

The content of organic matter is moderate and fertility medium in the Lihen soil. Permeability is rapid. Available water capacity is low. Runoff is slow.

Most areas support native grass. Many small areas are farmed along with adjacent soils. This soil is well suited to range. The natural vegetation dominantly is prairie sandreed, little bluestem, and sand bluestem. Switchgrass and needleandthread are less extensive. Overused areas are dominated by prairie sandreed. After continued overuse, bare areas are common and wind erosion is a serious problem.

This soil generally is unsuited to cultivated crops because it is susceptible to wind erosion. A cover of tame pasture plants or hay is effective in controlling wind erosion. A mulch of crop residue helps to control wind erosion until the pasture plants are established. Suitable species are alfalfa, intermediate wheatgrass, and smooth bromegrass.

This soil is poorly suited to windbreaks and environmental plantings. The species selected for planting should be limited to evergreens. Planting the trees in sod or crop aftermath without prior site preparation helps to control wind erosion.

Because of the slope, this soil is only fairly well suited to most kinds of building site development. Land shaping is needed in most areas. The sides of shallow excavations tend to cave in unless they are shored. In the less sloping areas, the soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water.

The capability subclass is VIe; Sands range site.

54B—Tansem-Roseglen loams, 2 to 6 percent slopes. These deep, gently undulating and undulating soils are on lake plains. The well drained Tansem soil is on the higher convex parts of the landscape. The moderately well drained Roseglen soil is in swales and the lower concave areas. In some of the higher lying areas, scattered stones are on the surface. Areas are irregular in shape and range from 20 to more than 400 acres in size. They are 50 to 60 percent Tansem soil and 20 to 30 percent Roseglen soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Tansem soil is dark grayish brown loam about 7 inches thick. The subsoil is dark grayish brown, friable loam about 8 inches thick. The upper 14 inches of the underlying material is white, calcareous silt loam. The next 25 inches is light gray and light brownish gray, calcareous loam. The lower part to a depth of 60 inches is light brownish gray, calcareous clay loam stratified with thin layers of very fine sand.

Typically, the surface layer of the Roseglen soil is dark gray loam about 9 inches thick. The subsoil is grayish brown and light brownish gray, friable loam about 24 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The upper part of the underlying material is white, calcareous silt loam. The next part is light yellowish brown, calcareous gravelly sand. The lower part to a depth of 60 inches is light gray, calcareous, stratified sandy loam to clay loam.

Included with these soils in mapping are small areas of Bryant, Grassna, Lehr, and Tansem Variant soils. These included soils make up less than 15 percent of any one mapped area. Bryant and Grassna soils contain more silt and less sand between depths of 10 and 40 inches than the Tansem and Roseglen soils. Bryant soils are in positions on the landscape similar to those of the Tansem soil, and Grassna soils are in positions similar to those of the Roseglen soil. Lehr soils have gravelly sand within a depth of 20 inches. They occur as areas intermingled with areas of the Tansem soil. Tansem Variant soils have lime near the surface. They are on narrow, convex ridges.

The content of organic matter is moderate and fertility medium in the Tansem soil. The content of organic matter and fertility are high in the Roseglen soil. Permeability is moderate in both soils. Available water capacity is high. Runoff is medium on the Tansem soil and slow on the Roseglen soil. The shrink-swell potential is moderate in both soils.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to alfalfa, intermediate wheatgrass, and smooth bromegrass for tame pasture and hay. Measures that control erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface. Contour farming and terracing also can help to control erosion, but slopes generally are too short and irregular for contouring and terracing. Grassed waterways help to keep gullies from forming.

These soils are well suited to range. The native vegetation dominantly is western wheatgrass and needlegrasses. Overused areas are dominated by western wheatgrass, needleandthread, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs grow well. Those that require an abundant supply of moisture grow well on the Roseglen soil.

The Tansem soil is well suited to most kinds of building site development. The Roseglen soil is only fairly well suited because of the moderate shrink-swell potential. Backfilling with sandy material, providing foundation drains and diverting runoff away from the buildings, however, help to prevent the structure damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. These soils are well suited to septic tank absorption fields.

The Tansem soil is in capability subclass IIe, the Roseglen soil in capability subclass IIc; both soils are in Silty range site.

55A—Parshall-Tally fine sandy loams, 0 to 3 percent slopes. These deep, nearly level and gently undulating, well drained soils are on uplands. The Parshall soil is on smooth slopes or in shallow swales, and the Tally soil is on the higher convex parts of the landscape. Areas are irregular in shape and 10 to 100 acres in size. They are 40 to 45 percent Parshall soil and 35 to 40 percent Tally soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Parshall soil is dark gray fine sandy loam about 8 inches thick. The subsoil is dark gray, very friable fine sandy loam about 11 inches thick. The upper part of the underlying material is dark grayish brown fine sandy loam. The lower part to a depth of 60 inches is grayish brown loamy sand. In some areas a gravelly layer is below a depth of 40 inches.

Typically, the surface layer of the Tally soil is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is grayish brown, brown, and light brownish gray, friable fine sandy loam about 20 inches thick. The underlying material to a depth of 60 inches is light brownish gray loamy fine sand and loamy sand. In places shaly clay loam glacial till is within a depth of 40 inches.

Included with these soils in mapping are small areas of Letcher, Niobell, Noonan, and Williams soils. These included soils make up less than 20 percent of any one mapped area. Williams soils contain more clay in the subsoil than the Parshall and Tally soils. Their position on the landscape is similar to that of the Tally soil. Letcher, Niobell, and Noonan soils have a sodium affected subsoil. They are on the lower parts of the landscape.

The content of organic matter is moderate and fertility medium in the Tally and Parshall soils. Permeability is moderately rapid. Available water capacity is moderate. Runoff is slow.

Most of the acreage is cropland. These soils are fairly well suited to cultivated crops. Measures that control wind erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface, field windbreaks, stubble mulching, and stripcropping.

A cover of tame pasture plants or hay is effective in controlling erosion. A mulch of crop residue helps to control wind erosion until the pasture plants are established. Suitable species are alfalfa, intermediate wheatgrass, and smooth bromegrass.

These soils are well suited to range. The native vegetation dominantly is bluestems, needleandthread, and prairie sandreed. Overused areas are dominated by prairie sandreed, blue grama, needleandthread, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. The climatically suited trees and shrubs generally grow well on both soils, but those that require an abundant supply of moisture do not grow well on the Tally soil. Preparing the site for planting in the spring reduces the hazard of wind erosion.

These soils are well suited to building site development, but the sides of shallow excavations tend to cave in unless they are shored. Septic tank absorption fields function well in these soils.

The capability subclass is IIIe; Sandy range site.

55B—Tally fine sandy loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on uplands. Areas are irregular in shape and 10 to 150 acres in size. Slopes are smooth and convex.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is grayish brown, brown, and light brownish gray, friable fine sandy loam about 20 inches thick. The underlying material to a depth of 60 inches is light brownish gray loamy fine sand and loamy sand. In some areas the subsoil and underlying material contain more sand. In other areas shaly clay loam glacial till is within a depth of 40 inches.

Included with this soil in mapping are small areas of Letcher, Niobell, Noonan, Parshall, and Williams soils. These soils make up less than 15 percent of any one mapped area. Letcher, Niobell, and Noonan soils have a sodium affected subsoil. Parshall soils are dark to a depth of more than 16 inches. Letcher, Niobell, Noonan, and Parshall soils are on side slopes and the lower parts of the landscape. Williams soils contain more clay in the subsoil than the Tally soil. Their position on the landscape is similar to that of the Tally soil.

The content of organic matter is moderate and fertility medium in the Tally soil. Permeability is moderately rapid. Available water capacity is moderate. Runoff is slow.

Most of the acreage is cropland. This soil is fairly well suited to most cultivated crops. Controlling wind and water erosion is the main concern of management. Conserving moisture also is a concern. Tillage practices that leave crop residue on the surface and stripcropping help to control erosion and conserve moisture.

A cover of tame pasture plants or hay is effective in controlling erosion. A mulch of crop residue helps to control wind erosion until the pasture plants are established. Suitable species are alfalfa, crested wheatgrass, intermediate wheatgrass, and smooth bromegrass.

This soil is well suited to range. The native vegetation dominantly is bluestems, needleandthread, and prairie sandreed. Overused areas are dominated by prairie sandreed, blue grama, needleandthread, and Kentucky bluegrass.

This soil is well suited to windbreaks and environmental plantings. Except for those species that require an abundant supply of moisture, all of the climatically suited trees and shrubs grow well. Preparing the site for planting in the spring reduces the hazard of wind erosion.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend

to cave in unless they are shored. Septic tank absorption fields function well in this soil.

The capability subclass is IIIe; Sandy range site.

56D—Tansem Variant loam, 9 to 15 percent slopes. This deep, well drained, strongly sloping soil is on convex ridges and side slopes on lake plains. Scattered stones are on the surface of some ridgetops. Areas are irregular in shape and 20 to 150 acres in size. Slopes are smooth and convex.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The upper 26 inches of the underlying material is light brownish gray, calcareous loam and stratified very fine sandy loam, silt loam, and fine sand. The lower part to a depth of 60 inches is light gray, calcareous, stratified fine sand and silty clay loam. In some areas a thin layer of gravel is at the surface.

Included with this soil in mapping are small areas of Bryant, Lihen, Parshall, Vida, and Wabek soils. These soils make up less than 15 percent of any one mapped area. Bryant soils contain more clay and silt in the subsoil than the Tansem Variant soil. They are on the lower side slopes. Lihen soils contain less silt and more sand between depths of 10 and 40 inches than the Tansem Variant soil. Their position on the landscape is similar to that of the Tansem Variant soil. Parshall soils are dark to a depth of more than 16 inches. They are in swales. Vida soils formed in clay loam glacial till. They are on the lower parts of the landscape. Wabek soils are underlain by gravelly sand within a depth of 14 inches. They are in positions on the landscape similar to those of the Tansem Variant soil.

The content of organic matter is moderate and fertility low in the Tansem Variant soil. Permeability is moderate. Available water capacity is high. Runoff is medium.

Although most of the acreage is cropland, this soil generally is unsuited to cultivated crops. Because of the slope and the high content of lime in the surface layer, it is highly susceptible to wind and water erosion.

This soil is fairly well suited to tame pasture and hay. A cover of tame pasture plants or hay is effective in controlling erosion. The high content of lime in the surface layer adversely affects the availability of plant nutrients. Alfalfa, crested wheatgrass, intermediate wheatgrass, pubescent wheatgrass, and smooth bromegrass are suitable.

This soil is well suited to range. The native vegetation is mainly little bluestem, sideoats grama, western wheatgrass, and needleandthread. Overused areas are dominated by sideoats grama, needleandthread, and blue grama.

This soil is poorly suited to windbreaks and environmental plantings because the high content of lime adversely affects the availability of plant nutrients. Trees or shrubs can be established, but optimum survival, growth, and vigor are not likely.

Because of the slope, this soil is only fairly well suited to building site development and septic tank absorption fields. The buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is needed. Land shaping and installing the distribution lines across the slope improve the efficiency of septic tank absorption fields.

The capability subclass is VIe; Thin Upland range site.

57A—Bryant-Grassna silt loams, 0 to 3 percent slopes. These deep, nearly level soils are on uplands. The well drained Bryant soil is on the higher convex parts of the landscape. The moderately well drained Grassna soil is in swales and on the lower concave parts of the landscape. It is occasionally flooded for very brief periods. Areas are irregular in shape and 5 to 350 acres in size. They are 50 to 60 percent Bryant soil and 25 to 30 percent Grassna soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Bryant soil is dark grayish brown silt loam about 7 inches thick. The subsoil is grayish brown and light brownish gray, friable silt loam about 16 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous silt loam and loam. In places clay loam glacial till is within a depth of 40 inches.

Typically, the surface layer of the Grassna soil is dark gray silt loam about 16 inches thick. The subsoil is dark grayish brown, friable silt loam about 18 inches thick. The underlying material to a depth of 60 inches is light gray, calcareous silt loam. In some areas the subsoil contains more clay. In other areas glacial till is within a depth of 40 inches.

Included with these soils in mapping are small areas of Nishon, Temvik, Tonka, Vida, and Williams soils. These included soils make up less than 20 percent of any one mapped area. The poorly drained Nishon and Tonka soils are in depressions. Temvik soils have glacial till within a depth of 40 inches. They are higher on the landscape than the Bryant soil. Vida and Williams soils contain more sand and less silt in the subsoil than the Bryant and Grassna soils. They are on the higher parts of the landscape.

The content of organic matter is moderate and fertility medium in the Bryant soil. The content of organic matter and fertility are high in the Grassna soil. Permeability is moderate in both soils. Available water capacity is high. The Grassna soil has a water table at a depth of 4 to 6 feet during wet periods. Runoff is slow on both soils. The shrink-swell potential is moderate in the Grassna soil.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to alfalfa, intermediate wheatgrass, and smooth bromegrass for tame pasture and hay. Because the Grassna soil receives runoff from the adjacent uplands, planting and harvesting are delayed in some wet years. Measures that conserve moisture and control erosion are the main management

needs. Examples are tillage practices that leave crop residue on the surface. Grassed waterways help to keep gullies from forming.

These soils are well suited to range. The native vegetation on the Bryant soil dominantly is western wheatgrass and needlegrasses. That on the Grassna soil dominantly is big bluestem and lesser amounts of western wheatgrass and green needlegrass. Overused areas are dominated by western wheatgrass, needleandthread, blue grama, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well on the Bryant soil, except for those that require an abundant supply of moisture. Those that require an abundant moisture supply grow especially well on the Grassna soil.

The Bryant soil is well suited to building site development and to septic tank absorption fields. The Grassna soil, however, generally is unsuited because of the flooding.

The capability subclass is IIc; the Bryant soil is in Silty range site, the Grassna soil in Overflow range site.

57B—Bryant-Grassna silt loams, 1 to 6 percent slopes. These deep, nearly level to gently sloping soils are on uplands. The well drained Bryant soil is on the higher convex parts of the landscape. The moderately well drained Grassna soil is on toe slopes and in swales. It is occasionally flooded for very brief periods. Areas are irregular in shape and 5 to more than 1,400 acres in size. They are 55 to 65 percent Bryant soil and 25 to 30 percent Grassna soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Bryant soil is dark grayish brown silt loam about 7 inches thick. The subsoil is grayish brown and light brownish gray, friable silt loam about 16 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous silt loam and loam. In places the surface layer is calcareous.

Typically, the surface layer of the Grassna soil is dark gray silt loam about 16 inches thick. The subsoil is dark grayish brown, friable silt loam about 18 inches thick. The underlying material to a depth of 60 inches is light gray, calcareous silt loam. In some areas the subsoil contains more clay. In other areas glacial till is within a depth of 40 inches.

Included with these soils in mapping are small areas of Nishon, Temvik, Tonka, Vida, and Williams soils. These included soils make up less than 20 percent of any one mapped area. The poorly drained Nishon and Tonka soils are in depressions. Temvik soils have glacial till within a depth of 40 inches. Vida and Williams soils contain more sand and less silt in the subsoil than the Bryant and Grassna soils.

The content of organic matter is moderate and fertility medium in the Bryant soil. The content of organic matter and fertility are high in the Grassna soil. Permeability is moderate in both soils. Available water capacity is high. The Grassna soil has a water table at a depth of 4 to 6 feet during wet periods. Runoff is slow on both soils. The shrink-swell potential is moderate in the Grassna soil.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to alfalfa, intermediate wheatgrass, and smooth bromegrass for tame pasture and hay. Planting and harvesting are delayed on the Grassna soil during some wet periods. Measures that control erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface.

These soils are well suited to range. The native vegetation on the Bryant soil dominantly is western wheatgrass and needlegrasses. That on the Grassna soil dominantly is big bluestem and lesser amounts of western wheatgrass and green needlegrasses. Overused areas are dominated by western wheatgrass, needleandthread, blue grama, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well on the Bryant soil, except for those that require an abundant supply of moisture. Those that require an abundant moisture supply grow especially well on the Grassna soil.

The Bryant soil is well suited to most kinds of building site development and to septic tank absorption fields. The Grassna soil, however, generally is unsuited because of the flooding.

The Bryant soil is in capability subclass IIe, Silty range site; the Grassna soil is in capability subclass IIc, Overflow range site.

57C—Bryant silt loam, 6 to 9 percent slopes. This deep, well drained, moderately sloping soil is on uplands. Areas are irregular in shape and 5 to 85 acres in size. Slopes are smooth and convex.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is grayish brown and light brownish gray, friable silt loam about 16 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous silt loam and loam. In places the surface layer is calcareous.

Included with this soil in mapping are small areas of Grassna, Tally, Wabek, and Williams soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Grassna soils are in swales. Tally and Williams soils occur as areas intermingled with areas of the Bryant soil. Tally soils contain more sand throughout and less silt between depths of 10 and 40 inches than the Bryant soil, and Williams soils contain more sand and less silt in the subsoil. Wabek soils have gravelly sand within a depth of 14 inches. They are on the higher convex parts of the landscape.

The content of organic matter is moderate and fertility medium in the Bryant soil. Permeability is moderate. Available water capacity is high. Runoff is medium.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to alfalfa, intermediate wheatgrass, and smooth bromegrass for tame pasture and hay. Measures that control erosion and conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface, contour farming, and terracing. Grassed waterways help to keep gullies from forming.

This soil is well suited to range. The native vegetation dominantly is green needlegrass, western wheatgrass, and needleandthread. Overused areas are dominated by western wheatgrass, blue grama, and needleandthread. After continued overuse, the site is dominated by blue grama and Kentucky bluegrass.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, except for those that require an abundant supply of moisture. Planting on the contour helps to control erosion.

This soil is well suited to most kinds of building site development and to septic tank absorption fields.

The capability subclass is IIIe; Silty range site.

58B—Temvik-Grassna-Bearpaw complex, 1 to 6 percent slopes. These deep, nearly level to gently sloping soils are on uplands. The well drained Temvik soil is on the middle side slopes. The moderately well drained Grassna soil is on the lower side slopes and in swales adjacent to drainageways. It is occasionally flooded for very brief periods. The well drained Bearpaw soil is on the upper side slopes and near the head of drainageways. Areas are irregular in shape and 50 to 400 acres in size. They are 30 to 40 percent Temvik soil, 25 to 35 percent Grassna soil, and 20 to 30 percent Bearpaw soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Temvik soil is dark grayish brown silt loam about 8 inches thick. The subsoil is grayish brown and light brownish gray, friable silt loam about 19 inches thick. The upper part of the underlying material is light brownish gray, calcareous loam. The lower part to a depth of 60 inches is light brownish gray and light gray, calcareous clay loam glacial till. In places the clay loam glacial till is below a depth of 40 inches.

Typically, the surface layer of the Grassna soil is dark gray silt loam about 16 inches thick. The subsoil is dark grayish brown, friable silt loam about 18 inches thick. The underlying material to a depth of 60 inches is light gray, calcareous silt loam. In some areas the subsoil contains more clay. In other areas loam or clay loam glacial till is within a depth of 40 inches.

Typically, the surface layer of the Bearpaw soil is dark grayish brown loam about 5 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray, firm clay loam about 15 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In eroded areas calcareous clay loam is at the surface.

Included with these soils in mapping are small areas of Grail soils in similar positions on the landscape. These included soils make up less than 10 percent of any one mapped area. They contain more clay in the subsoil than the Grassna soil.

The content of organic matter and fertility are high in the Temvik and Grassna soils. The content of organic matter is moderate and fertility medium in the Bearpaw soil. Permeability is moderate in the subsoil of the Temvik soil and moderately slow in the underlying material. It is moderate in the Grassna soil and is moderately slow in the subsoil of the Bearpaw soil and slow in the underlying material. Available water capacity is high in the Temvik and Grassna soils and moderate or high in the Bearpaw soil. The Grassna soil has a water table at a depth of 4 to 6 feet during wet periods. Runoff is medium on the Temvik and Bearpaw soils and slow on the Grassna soil. The shrink-swell potential is high in the subsoil and underlying material of the Bearpaw soil. It is moderate in the Temvik and Grassna soils.

Most of the acreage is cropland. The Temvik and Grassna soils are well suited and the Bearpaw soil is fairly well suited to cultivated crops. Measures that control erosion and conserve moisture are the main management needs. Examples are leaving crop residue on the surface when the soils are tilled and including grasses and legumes in the cropping system. Contour farming and terraces also can help to control erosion, but in most areas the slopes are too short or too irregular for terracing and contouring. Because of the runoff from adjacent soils, planting and harvesting are delayed on Grassna soil during some wet periods.

These soils are well suited to tame pasture and hay. A cover of tame pasture plants or hay is effective in controlling erosion. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable.

These soils are well suited to range. The native vegetation dominantly is needlegrasses, western wheatgrass, and bluestems. Overused areas are dominated by western wheatgrass and needleandthread. After continued overuse, short grasses, such as blue grama and Kentucky bluegrass, are dominant.

These soils are well suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs grow well. Those that require an abundant supply of moisture grow well on the Grassna soil.

Because of the shrink-swell potential, the Temvik soil is only fairly well suited and the Bearpaw soil poorly suited to building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent

the structure damage caused by shrinking and swelling. The Temvik and Bearpaw soils are poorly suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area of these fields, however, helps to overcome the slow absorption of liquid waste. The Grassna soil generally is unsuited to building site development and septic tank absorption fields because of the flooding.

The Temvik soil is in capability subclass IIe, Silty range site; the Grassna soil is in capability subclass IIc, Overflow range site; and the Bearpaw soil is in capability subclass IIIe, Clayey range site.

62—Hamerly loam. This deep, somewhat poorly drained, nearly level soil is in swales and on flats that surround shallow depressions. Areas are irregular in shape and 5 to 70 acres in size. Slopes are smooth or slightly concave.

Typically, the surface layer is dark gray, calcareous loam about 13 inches thick. The underlying material to a depth of 60 inches is gray and light brownish gray, calcareous clay loam. In places the soil has visible salt crystals throughout.

Included with this soil in mapping are small areas of Bowbells, Tonka, Vallers, and Williams soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Bowbells and well drained Williams soils are higher on the landscape than the Hamerly soil. The poorly drained Tonka and Vallers soils are in depressions. Also included are saline spots as much as 3 acres in size.

The content of organic matter is high and fertility medium in the Hamerly soil. Permeability is moderate in the upper part of the soil and moderately slow in the lower part. Available water capacity is high. A water table is at a depth of 2.0 to 4.0 feet during wet periods. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to alfalfa, intermediate wheatgrass, and smooth bromegrass for tame pasture and hay. The high content of lime in the surface layer, however, adversely affects the availability of plant nutrients and increases the susceptibility to wind erosion. Measures that control wind erosion are the main management needs. Examples are tillage practices that leave crop residue on the surface and stripcropping.

This soil is well suited to range. The native vegetation dominantly is bluestems, needlegrasses, and western wheatgrass. Overused areas are dominated by western wheatgrass and needleandthread. After continued overuse, short grasses, such as blue grama and Kentucky bluegrass, dominate the site.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil generally is unsuited to most kinds of building site development and to septic tank absorption fields because of the wetness.

The capability subclass is IIe; Limy Subirrigated range site.

64—Grassna silt loam. This deep, moderately well drained, nearly level soil is in swales on uplands. It is occasionally flooded for very brief periods. Areas are long and narrow and 5 to 140 acres in size. Slopes are smooth and slightly concave.

Typically, the surface layer is dark gray silt loam about 16 inches thick. The subsoil is dark grayish brown, friable silt loam about 18 inches thick. The underlying material to a depth of 60 inches is light gray, calcareous silt loam. In some areas the subsoil contains more clay. In other areas loam or clay loam glacial till is within a depth of 40 inches.

Included with this soil in mapping are small areas of Bryant and Tonka soils. These soils make up less than 15 percent of any one mapped area. The well drained Bryant soils are on the higher parts of the landscape. The poorly drained Tonka soils are in depressions.

The content of organic matter and fertility are high in the Grassna soil. Permeability is moderate. Available water capacity is high. A water table is at a depth of 4 to 6 feet during wet periods. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to alfalfa, intermediate wheatgrass, and smooth bromegrass for tame pasture and hay. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on surface. In some years planting is delayed because of the wetness caused by runoff from the adjacent uplands.

This soil is well suited to range. The native vegetation dominantly is big bluestem and lesser amounts of western wheatgrass and green needlegrass. Overused areas are dominated by western wheatgrass and Kentucky bluegrass.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil generally is unsuited to building site development and to septic tank absorption fields because of the flooding.

The capability subclass is IIc; Overflow range site.

65—Grail silty clay loam. This deep, moderately well drained, nearly level soil is in swales, on toe slopes, and in broad low areas on uplands. It is frequently flooded for very brief periods. Areas are irregular in shape and 5 to 40 acres in size. Slopes are smooth or slightly concave.

Typically, the surface layer is dark gray silty clay loam about 6 inches thick. The subsoil is dark gray and gray, firm silty clay about 24 inches thick. The underlying material to a depth of 60 inches is light brownish gray, calcareous silty clay loam. In places the subsoil contains less clay.

Included with this soil in mapping are small areas of Mondamin, Tonka, and Williams soils. These soils make up less than 15 percent of any one mapped area. Mondamin soils are dark to a depth of less than 16 inches. They are slightly higher on the landscape than the Grail soil. The poorly drained Tonka soils are in depressions. The well drained Williams soils are on the higher parts of the landscape. They contain less clay in the subsoil than the Grail soil.

The content of organic matter and fertility are high in the Grail soil. Permeability is moderately slow. Available water capacity is high. A water table is at a depth of 3 to 6 feet during wet periods. Runoff is slow. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Measures that conserve moisture are the main management needs. Examples are tillage practices that leave crop residue on the surface. Fieldwork is delayed during periods when the soil is flooded by runoff from the adjacent uplands.

This soil is well suited to range. The native vegetation dominantly is big bluestem, western wheatgrass, and green needlegrass. Overused areas are dominated by western wheatgrass and Kentucky bluegrass.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil generally is unsuited to building site development and septic tank absorption fields because of the flooding.

The capability subclass is IIc; Overflow range site.

72—Ranslo-Harriet loams. These deep, nearly level soils are on flood plains that are occasionally flooded for very brief or long periods. A meandering stream channel dissects many areas. The somewhat poorly drained Ranslo soil is on slight rises. The poorly drained Harriet soil is in slight depressions and the lower areas near the channels. Areas are long and narrow and 20 to more than 600 acres in size. They are 40 to 50 percent Ranslo soil and 35 to 45 percent Harriet soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Ranslo soil is dark gray loam about 10 inches thick. The subsurface layer is gray loam about 5 inches thick. The subsoil is dark gray, dark grayish brown, and light brownish gray, firm clay loam about 18 inches thick. In the lower part it is calcareous and has nests of salts that extend into the underlying material. The underlying material to a depth of 60 inches is light gray and light brownish gray, calcareous clay loam. In places the subsoil contains less clay.

Typically, the surface layer of the Harriet soil is gray loam about 2 inches thick. The subsoil is dark gray, firm clay loam about 13 inches thick. It has nests of salts that extend into the underlying material. The upper part of the underlying material is light olive gray, calcareous, stratified loam and clay loam. The lower part to a depth of 60 inches is light brownish gray sandy loam and gravelly loam. In places the subsoil does not have columnar structure.

Included with these soils in mapping are small areas of Lehr, Miranda, and Straw soils. These included soils make up less than 15 percent of any one mapped area. Lehr soils have gravelly sand at a depth of 14 to 20 inches. They are on terraces. Miranda soils contain more sand and less clay in the subsoil than the Harriet soil. They are on uplands. Straw soils do not have a sodium affected subsoil. They are along drainageways.

The content of organic matter is high and fertility medium in the Ranslo soil. The content of organic matter is moderate and fertility low or medium in the Harriet soil. Tilth is poor in both soils. Permeability is slow in the Ranslo soil and very slow in the Harriet soil. Available water capacity is moderate or high in the Ranslo soil and moderate in the Harriet soil. Both soils have a sodium affected subsoil that restricts root penetration. During wet periods the water table is at a depth of 1 to 3 feet in the Ranslo soil and is within 1 foot of the surface in the Harriet soil. Runoff is slow on both soils. The shrink-swell potential is high.

Most of the acreage supports native grasses and is used for grazing. These soils are better suited to range than to cropland. The native vegetation on the Ranslo soil dominantly is big bluestem and lesser amounts of switchgrass and western wheatgrass. Overused areas are dominated by western wheatgrass, inland saltgrass, and Kentucky bluegrass. The native grasses on the Harriet soil dominantly are saltgrass and western wheatgrass. In overused areas, the stand thins out severely and bare ground is common. Grazing during wet periods causes compaction of the surface layer, which results in an increase in the extent of the less desirable grasses and of weeds.

These soils are poorly suited to cultivated crops because of the flooding, the sodium affected subsoil, and the meandering channels. The main management needs are measures that control flooding, improve tilth, and increase the rate of water intake. Leaving crop residue on the surface when the soils are tilled, chiseling or subsoiling, and including grasses and legumes in the cropping system increase the rate of water intake, improve tilth, and conserve moisture.

The Ranslo soil is fairly well suited to tame pasture and hay, but the Harriet soil is poorly suited. The dense, compact subsoil, the high content of salts, and the flooding limit the number of suitable species and the growth of plants. Garrison creeping foxtail, reed canarygrass, and tall wheatgrass are the best suited species.

The Ranslo soil is well suited to windbreaks and environmental plantings, but the Harriet soil generally is unsuited. All climatically suited trees and shrubs grow

well on the Ranslo soil. No trees and shrubs grow well on the Harriet soil. Field windbreaks can be established, but their effectiveness is greatly reduced because tree growth is severely restricted.

These soils generally are unsuited to building site development and septic tank absorption fields because of the wetness and the flooding.

The Ranslo soil is in capability subclass IIIw, Subirrigated range site; the Harriet soil is in capability subclass VIw, Saline Lowland range site.

75—Tonka-Nishon silt loams. These deep, poorly drained, level soils are in depressions in the uplands. The Tonka soil generally is in the center of the depressions and is surrounded by the Nishon soil. Slopes are smooth or slightly concave. Both soils are ponded during spring runoff and after heavy rainfall. In some areas scattered stones are on the surface and in the soil. Areas are irregular in shape or oval and are 5 to 30 acres in size. They are 45 to 55 percent Tonka soil and 35 to 45 percent Nishon soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Tonka soil is dark gray silt loam about 8 inches thick. The subsurface layer is light gray loam about 4 inches thick. The subsoil is about 30 inches of dark gray, grayish brown, and light brownish gray, firm silty clay and silty clay loam. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is light gray, calcareous clay loam.

Typically, the surface layer of the Nishon soil is gray silt loam about 3 inches thick. The subsurface layer is gray silt loam about 4 inches thick. The subsoil is dark gray, firm silty clay about 20 inches thick. The underlying material to a depth of 60 inches is dark gray and light gray, firm, calcareous clay loam.

Included with these soils in mapping are small areas of Bowbells and Parnell soils. These included soils make up less than 15 percent of any one mapped area. The moderately well drained Bowbells soils are near the edges of the depressions. The very poorly drained Parnell soils are slightly lower on the landscape than the Tonka and Nishon soils.

The content of organic matter is high in the Tonka and Nishon soils. Fertility is high in the Tonka soil and medium in the Nishon soil. Permeability is slow in the Tonka soil and slow or very slow in the Nishon soil. Available water capacity is high in the Tonka soil and moderate or high in the Nishon soil. During wet periods on both soils, a water table is as much as 0.5 foot above the surface or is within a depth of 1 foot. Runoff is ponded. The shrink-swell potential is high.

Most of the acreage supports native grasses and is used for grazing. The Tonka soil is well suited and the Nishon soil fairly well suited to range. The native vegetation dominantly is sedges on the Tonka soil and western wheatgrass on the Nishon soil. Prairie cordgrass is less extensive on both soils. Overused areas are dominated by inland saltgrass, Kentucky bluegrass, foxtail barley, and curlycup gumweed. Smartweed, sedges, and rushes increase in extent during wet periods.

Some areas are cultivated along with the surrounding areas. These soils are poorly suited to cultivated crops because of the dense, compact subsoil and the ponding. Crops commonly drown out. Suitable drainage outlets generally are not available.

These soils are only fairly well suited to tame pasture and hay because they are wet. The choice of suitable tame pasture plants is limited to water tolerant species, such as Garrison creeping foxtail and reed canarygrass. A drainage system cannot be installed in most areas.

These soils generally are unsuited to windbreaks and environmental plantings unless they are drained. The trees and shrubs that require an abundant supply of moisture grow well in drained areas.

These soils are poorly suited to building site development and septic tank absorption fields because of the ponding.

The capability subclass is IVw; the Tonka soil is in Wet Meadow range site, the Nishon soil in Closed Depression range site.

76—Parnell silty clay loam. This deep, very poorly drained, level soil is in depressions in the uplands. It is ponded for long periods. In some areas scattered stones are on the surface and in the soil. Areas are circular and 3 to 80 acres in size. Slopes are concave.

Typically, the surface layer is dark gray silty clay loam about 7 inches thick. The subsoil is dark gray and gray, firm silty clay about 38 inches thick. The underlying material to a depth of 60 inches is gray silty clay. In places clay loam glacial till is below a depth of 40 inches.

Included with this soil in mapping are small areas of the poorly drained Tonka and Vallers soils. These soils make up less than 10 percent of any one mapped area. Tonka soils are on the higher parts of the larger depressions. Vallers soils are on the outer edges of the depressions.

The content of organic matter and fertility are high in the Parnell soil. Permeability is slow. Available water capacity is moderate or high. A seasonal high water table is as much as 2 feet above the surface or as much as 2 feet below. Runoff is ponded. The shrink-swell potential is high.

Most of the acreage is range. A few small areas are cultivated along with adjacent areas. This soil is fairly well suited to range. The natural vegetation dominantly is sedges, rivergrass, and prairie cordgrass. Overused areas are dominated by Kentucky bluegrass, saltgrass, sedges, and rushes. Many areas are good sites for stock water dugouts.

This soil is generally unsuited to cultivated crops and to windbreaks and environmental plantings because of

the ponding. It is fairly well suited to tame pasture and hay. Because the soil generally cannot be artificially drained, the choice of tame pasture plants is limited to water tolerant grasses. Garrison creeping foxtail and reed canarygrass are examples.

This soil generally is unsuited to building site development and septic tank absorption fields because of the ponding.

The capability subclass is Vw; Shallow Marsh range site.

77—Nishon-Heil silt loams. These deep, poorly drained, level soils are in shallow depressions. They are ponded during snowmelt and heavy rainfall. In some areas the Heil soil is lower on the landscape than the Nishon soil. Areas are irregular in shape and 5 to 100 acres in size. They are 45 to 55 percent Nishon soil and 35 to 45 percent Heil soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Nishon soil is gray silt loam about 3 inches thick. The subsurface layer is gray silt loam about 4 inches thick. The subsoil is dark gray, firm silty clay about 20 inches thick. The underlying material to a depth of 60 inches is dark gray and light gray, firm, calcareous clay loam.

Typically, the surface layer of the Heil soil is gray silt loam about 2 inches thick. The subsoil is dark gray and gray, firm clay about 24 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is gray, calcareous silty clay and clay loam.

Included with these soils in mapping are small areas of Miranda and Tonka soils. These included soils make up less than 10 percent of any one mapped area. The moderately well drained Miranda soils are in the slightly higher areas at the outer edges of the depressions. Tonka soils have a surface layer that is 8 to 15 inches thick. They are in positions on the landscape similar to those of the Nishon soil.

The content of organic matter is high and fertility medium in the Nishon and Heil soils. Permeability is slow or very slow in the Nishon soil and very slow in the Heil soil. Available water capacity is moderate or high in the Nishon soil and moderate in the Heil soil. During wet periods a water table is as much as 0.5 foot above the surface of the Nishon soil or as much as 1 foot below and is as much as 1 foot above the surface of the Heil soil or as much as 1 foot below. Runoff is ponded on both soils. The shrink-swell potential is high. The dense, compact subsoil in both soils restricts root penetration.

Most of the acreage supports native grasses and is used for grazing. These soils are fairly well suited to range. The native vegetation dominantly is western wheatgrass and lesser amounts of bluegrass, sedges, and forbs. Overused areas are dominated by Kentucky bluegrass, inland saltgrass, curlycup gumweed, and foxtail barley. Smartweed, sedges, and rushes increase in extent during wet periods. The surface layer in both soils is puddled if the range has been grazed during wet periods. This puddling results in an increase in the extent of the less desirable plants.

Although a few areas are cultivated along with the surrounding areas, these soils are poorly suited to cropland. The dense, compact subsoil and the ponding are the main limitations.

These soils are fairly well suited to tame pasture and hay. The choice of tame pasture plants is limited because natural drainage is restricted and artificial drainage is not feasible. Garrison creeping foxtail, western wheatgrass, and reed canarygrass are suitable.

These soils generally are unsuited to windbreaks or environmental plantings. The inadequate drainage and the dense, compact subsoil severely limit the growth and survival of trees and shrubs.

These soils are unsuited to building site development and septic tank absorption fields because of the ponding.

The Nishon soil is in capability subclass IVw, Closed Depression range site; the Heil soil is in capability subclass VIs, Closed Depression range site.

80—Heil silt loam. This deep, poorly drained, level soil is in shallow depressions in the uplands. It is ponded during snowmelt and heavy rainfall. In some areas scattered stones are on the surface and in the soil. Areas are circular or irregularly shaped and 5 to 100 acres in size. Slopes are concave.

Typically, the surface layer is gray silt loam about 2 inches thick. The subsoil is dark gray and gray, firm clay about 24 inches thick. In the lower part it is calcareous and has accumulations of carbonate that extend into the underlying material. The underlying material to a depth of 60 inches is gray, calcareous silty clay and clay loam.

Included with this soil in mapping are small areas of Nishon, Parnell, and Tonka soils. These soils make up less than 5 percent of any one mapped area. They are in the lower part of some depressions. They do not have a sodium affected subsoil. Their surface layer is thicker than that of the Heil soil.

The content of organic matter is moderate and fertility medium in the Heil soil. The subsoil restricts root penetration because it is a dense, sodium affected claypan. Permeability is very slow. Available water capacity is moderate. During wet periods a seasonal high water table is as much as 1 foot above the surface or is within a depth of 1 foot. Runoff is ponded. The shrink-swell potential is high.

Most of the acreage is range. Many small areas are farmed along with adjacent areas. This soil is fairly well suited to range. The native vegetation dominantly is western wheatgrass and lesser amounts of sedges and forbs. Overused areas are dominated by Kentucky bluegrass and saltgrass. Sedges increase in extent during wet periods, and foxtail barley and curlycup

gumweed increase in extent during dry periods. The surface layer is puddled if the range is grazed during wet periods. This puddling results in an increase in the extent of the less desirable plants.

This soil generally is unsuited to cultivated crops and to windbreaks and environmental plantings. The dense, compact subsoil and the ponding are the main limitations.

This soil is fairly well suited to tame pasture and hay. The choice of tame pasture plants is limited because natural drainage is restricted and artificial drainage is not feasible and because the surface layer is thin and the subsoil dense and compact. Garrison creeping foxtail and reed canarygrass are suitable.

This soil generally is unsuited to building site development and septic tank absorption fields because of the ponding.

The capability is subclass VIs; Closed Depression range site.

82—Stirum loam. This deep, poorly drained, level soil is in depressions in the uplands. It is ponded during snowmelt and after heavy rainfall. Areas are circular or oblong and 20 to 160 acres in size.

Typically, the surface layer is gray loam about 6 inches thick. The subsurface layer is gray fine sandy loam about 2 inches thick. The subsoil is grayish brown and light brownish gray sandy clay loam about 11 inches thick. The upper part of the underlying material is light brownish gray and light gray loamy sand. The lower part to a depth of 60 inches is light gray clay loam.

Included with this soil in mapping are small areas of Letcher and Nishon soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Letcher soils are higher on the landscape than the Stirum soil. Nishon soils do not have a sodium affected subsoil. They are near the edges of the depressions.

The content of organic matter is moderate and fertility medium in the Stirum soil. Permeability is slow. Available water capacity is moderate. During wet periods a seasonal high water table is as much as 0.5 foot above the surface or is within a depth of 1 foot. Runoff is ponded.

Most of the acreage supports native grasses and is used for grazing. This soil is well suited to range. The native vegetation dominantly is big bluestem and lesser amounts of switchgrass. Overused areas are dominated by western wheatgrass, foxtail barley, inland saltgrass, and Kentucky bluegrass.

This soil is fairly well suited to tame pasture and hay. The wetness limits the choice of pasture plants to water tolerant species. Garrison creeping foxtail and reed canarygrass are the best suited species.

This soil generally is unsuited to cultivated crops and to windbreaks and environmental plantings. The wetness is the main limitation. Also, the dense, sodium affected subsoil restricts root penetration.

This soil generally is unsuited to building site development and septic tank absorption fields because of the ponding.

The capability subclass is VIw; Subirrigated range site.

85—Ranslo loam. This deep, somewhat poorly drained, nearly level soil is on flood plains. It is occasionally flooded for very brief periods. Areas are long and narrow or irregular in shape. They are 25 to more than 400 acres in size. Slopes are smooth or slightly concave.

Typically, the surface layer is dark gray loam about 10 inches thick. The subsurface layer is gray loam about 5 inches thick. The subsoil is dark gray, dark grayish brown, and light brownish gray, firm clay loam about 18 inches thick. In the lower part it is calcareous and has nests of salts that extend into the underlying material. The underlying material to a depth of 60 inches is light gray and light brownish gray, calcareous clay loam. In places the subsoil contains less clay.

Included with this soil in mapping are small areas of Brantford, Harriet, and Miranda soils. These soils make up less than 10 percent of any one mapped area. The well drained Brantford soils are in the slightly higher convex areas. The poorly drained Harriet soils are in slight depressions. Miranda soils contain more sand throughout and less clay in the subsoil than the Ranslo soil. They are in the higher areas at the outer edge of the mapped areas.

The content of organic matter is high and fertility medium in the Ranslo soil. The sodium affected subsoil restricts root penetration. Permeability is slow. Available water capacity is moderate or high. A water table is at a depth of 1.0 to 3.0 feet during wet periods. Runoff is slow. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is only fairly well suited to cultivated crops, however, because of the flooding and the sodium affected subsoil. It is better suited to small grain than to corn because of the dense, compact subsoil. Measures that control the flooding and increase the rate of water intake are the main management needs. Leaving crop residue on the surface when the soil is tilled, chiseling or subsoiling, and including grasses or legumes in the cropping system increase the rate of water intake.

This soil is well suited to tame pasture and hay. Alfalfa, Garrison creeping foxtail, tall wheatgrass, reed canarygrass, and smooth bromegrass are suitable.

This soil is well suited to range. The native vegetation dominantly is big bluestem and lesser amounts of switchgrass and western wheatgrass. Overused areas are dominated by western wheatgrass, saltgrass, and Kentucky bluegrass.

This soil is well suited to windbreaks and environmental plantings. It is especially well suited to the trees and shrubs that require an abundant supply of moisture.

Because of the flooding, this soil generally is unsuited to building site development and septic tank absorption fields.

The capability subclass is IIIw; Subirrigated range site.

86—Harriet loam. This deep, poorly drained, nearly level soil is on flood plains. It is occasionally flooded for long periods. Areas are irregular in shape and 5 to more than 300 acres in size. Slopes are concave or smooth.

Typically, the surface layer is gray loam about 2 inches thick. The subsoil is dark gray, firm clay loam about 13 inches thick. The upper part of the underlying material is light olive gray, calcareous, stratified loam and clay loam. The lower part to a depth of 60 inches is light brownish gray sandy loam and gravelly loam. Nests of salts are in the subsoil and the underlying material.

Included with this soil in mapping are small areas of the somewhat poorly drained Ranslo soils on slight rises. These soils make up less than 10 percent of any one mapped area. Also included is a saline soil that does not have columnar structure in the subsoil. This included soil is in positions on the landscape similar to those of the Harriet soil.

The content of organic matter is moderate and fertility low or medium in the Harriet soil. The sodium affected subsoil restricts root penetration. Permeability is very slow. Available water capacity is moderate. A water table is within a depth of 1 foot during wet periods. Runoff is slow. The shrink-swell potential is high.

Nearly all of the acreage supports native grasses and is used for grazing. This soil is fairly well suited to range. The native vegetation dominantly is saltgrass and western wheatgrass. Overused areas are dominated by saltgrass and thin stands of western wheatgrass. Grazing when the soil is wet causes surface compaction and puddling, both of which result in a decrease in the extent of desirable grasses.

This soil generally is unsuited to cultivated crops and to windbreaks and environmental plantings. It is poorly suited to tame pasture and hay. The dense and compact subsoil, the high content of salts, and the flooding severely limit the choice of suitable species. Tall wheatgrass is the best suited species.

This soil generally is not suited to building site development and septic tank absorption fields because of the wetness and the flooding.

The capability subclass is VIw; Saline Lowland range site.

87—Marysland loam. This poorly drained, level soil is in depressions or beach areas surrounding marshes and bodies of water on outwash plains. It is subject to rare flooding. It is moderately deep over gravelly sand. Areas are irregular in shape and 5 to 90 acres in size. Slopes are smooth and slightly concave. Scattered stones are on the surface in some areas.

Typically, the surface layer is dark gray, calcareous loam about 6 inches thick. The subsurface layer is gray, calcareous loam about 5 inches thick. The upper part of the underlying material is light gray and gray, calcareous loam. The lower part to a depth of 60 inches is multicolored gravelly sand. In places the gravelly sand is within a depth of 20 inches. In some areas the soil is not so poorly drained.

Included with this soil in mapping are small areas of Bowdle, Lehr, and Vallers soils. These soils make up less than 10 percent of any one mapped area. The well drained Bowdle and somewhat excessively drained Lehr soils are on the higher parts of the landscape. Vallers soils formed in loam or clay loam glacial till. Their position on the landscape is similar to that of the Marysland soil.

The content of organic matter is high and fertility medium in the Marysland soil. Permeability is moderate in the upper part of the soil and rapid in the lower part of the underlying material. Available water capacity is moderate. A water table is at a depth of 1.0 to 2.5 feet during wet periods. Runoff is slow.

Most of the acreage supports native grasses and is used for grazing. This soil is well suited to range. The tall prairie grasses are highly productive because they benefit from the seasonal high water table. The native vegetation dominantly is bluestems. Overused areas are dominated by inland saltgrass, Kentucky bluegrass, and western wheatgrass.

This soil is poorly suited to cultivated crops. The wetness may delay tillage in the spring and during other parts of wet years. Artificial drainage generally is not feasible. The high content of lime in the surface layer adversely affects the availability of plant nutrients.

This soil is fairly well suited to tame pasture and hay. The choice of pasture plants, however, is limited mainly to water tolerant species. Garrison creeping foxtail and reed canarygrass are examples.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

Because of the wetness, this soil generally is unsuited to building site development and septic tank absorption fields.

The capability subclass is IVw; Subirrigated range site.

88—Divide loam. This somewhat poorly drained, nearly level soil is in depressions in outwash plains and on terraces and flood plains along glacial melt water channels. It is moderately deep over gravelly sand. Areas are irregular in shape and 5 to 220 acres in size. Slopes are smooth or slightly concave.

Typically, the surface layer is dark gray, calcareous loam about 8 inches thick. The upper part of the underlying material is light brownish gray, calcareous loam. The lower part to a depth of 60 inches is multicolored gravelly sand. In some areas the surface layer contains more sand. In other areas the soil is poorly drained.

Included with this soil in mapping are small areas of the well drained Bowdle and somewhat excessively drained Lehr soils. These soils make up less than 15 percent of any one mapped area. They are higher on the landscape than the Divide soil.

The content of organic matter is moderate and fertility medium in the Divide soil. Permeability is moderate in the upper part of the soil and rapid or very rapid in the underlying gravelly sand. Available water capacity is low or moderate. A water table is at a depth of 2.5 to 5 feet during wet periods. Runoff is slow.

Most of the acreage is cropland. This soil is only fairly well suited to cultivated crops, however, because the high content of lime adversely affects the availability of plant nutrients. In areas cut by many small drainage channels, the soil is unsuitable for cultivation. Wind erosion is a hazard. Tillage practices that leave crop residue on the surface and stripcropping help to control wind erosion, conserve moisture, and improve fertility.

A cover of tame pasture plants or hay is effective in controlling wind erosion. Alfalfa, crested wheatgrass, intermediate wheatgrass, and smooth bromegrass are suitable.

This soil is well suited to range. The native vegetation dominantly is bluestems, needlegrasses, and western wheatgrass. Overused areas are dominated by western wheatgrass, needleandthread, and blue grama.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

This soil is fairly well suited to most kinds of building site development. The seasonal high water table is a limitation on sites for buildings with basements. The sides of shallow excavations tend to cave in unless they are shored. The soil generally is unsuited to septic tank absorption fields because of the wetness.

The capability subclass is IIIs; Limy Subirrigated range site.

97—Regan silt loam, wet. This deep, very poorly drained, nearly level soil is in channels on outwash plains and flood plains. It is frequently flooded. Areas are long and narrow or irregular in shape. They are 5 to 200 acres in size. Slopes are smooth or concave.

Typically, the surface layer is dark gray, calcareous silt loam about 5 inches thick. The next 10 inches is gray, calcareous silt loam. The upper part of the underlying material is light gray and gray, calcareous silt loam. The lower part to a depth of 60 inches is gray, calcareous clay loam that is distinctly mottled and has accumulations of manganese oxide. In places gravelly sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Divide, Harriet, and Vallers soils. These soils make up less than 10 percent of any one mapped area. Divide soils have gravelly sand at a depth of 20 to 40 inches. They are higher on the landscape than the Regan soil. Harriet soils contain more salts than the Regan soil. They occur in a random pattern throughout the mapped areas. Vallers soils contain more sand than the Regan soil. They are on the outer edges of the mapped areas.

The content of organic matter is high and fertility medium in the Regan soil. Permeability is moderate or moderately slow. Available water capacity is medium or high. A water table is within a depth of 1 foot during wet periods. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is range. Hay is harvested in some areas during dry years. This soil is fairly well suited to range. The natural vegetation dominantly is prairie cordgrass and lesser amounts of sedges and reedgrass. Overgrazed areas are dominated by sedges, rushes, saltgrass, and Kentucky bluegrass.

This soil generally is unsuited to cultivated crops and to windbreaks and environmental plantings because of the water table at or near the surface most of the year. It is fairly well suited to tame pasture and hay. The number of suitable species is limited, however, because natural drainage is not adequate and artificial drainage is not feasible. Garrison creeping foxtail and reed canarygrass are suitable.

This soil generally is unsuited to building site development and septic tank absorption fields because of the flooding and the wetness.

The capability subclass is Vw; Wetland range site.

98—Vallers silty clay loam. This deep, poorly drained, nearly level soil is in shallow depressions, in drainageways, and on benches surrounding depressions. It is subject to rare flooding. Scattered stones are on the surface in some areas. Areas are long and narrow or irregularly shaped and 5 to 100 acres in size. Slopes are slightly concave.

Typically, the surface layer is gray, calcareous silty clay loam about 7 inches thick. Below this is a transitional layer of gray silty clay loam about 6 inches thick. The underlying material to a depth of 60 inches is gray and light gray, calcareous, friable clay loam. In places salt crystals are throughout the soil.

Included with this soil in mapping are small areas of Hamerly, Parnell, and Regan soils. These soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Hamerly soils are slightly higher on the landscape than the Vallers soil. Parnell and Regan soils are very poorly drained. Parnell soils are in depressions, and Regan soils are slightly lower on the landscape than the Vallers soil.

The content of organic matter is high and fertility medium in the Vallers soil. Permeability is moderately slow. Available water capacity is high. A water table is at a depth of 1 to 2.5 feet during wet periods. Runoff is slow.

Most of the acreage supports native grasses and is used for grazing. This soil is well suited to range. The tall prairie grasses are highly productive because they

benefit from the high water table. The natural vegetation dominantly is bluestems. Overused areas are dominated by inland saltgrass, Kentucky bluegrass, and western wheatgrass.

This soil is poorly suited to cultivated crops. The wetness delays tillage in the spring of most years. Artificial drainage generally is not feasible. The high content of lime in the surface layer adversely affects the availability of plant nutrients. Wind erosion is a hazard if cultivated crops are grown. Tillage practices that leave crop residue on the surface, inclusion of grasses and legumes in the cropping system, and timely tillage help to control wind erosion and improve fertility.

This soil is only fairly well suited to tame pasture and hay. The choice of suitable pasture plants is limited mainly to water tolerant species. Garrison creeping foxtail and reed canarygrass are examples.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well, especially those that require an abundant supply of moisture.

Because of the wetness and the flooding, this soil generally is unsuited to building site development and to septic tank absorption fields.

The capability subclass is IVw; Subirrigated range site.

99—Pits, gravel. These areas are open excavations, 5 to 30 feet deep, from which sand and gravel are being removed. They are irregular in shape and range from 5 to 15 acres in size. Slopes are uneven and broken. They range from nearly level on the pit bottoms to almost vertical on the rims. Some of the pit bottoms are covered with water.

The pit bottoms typically are sand and gravel, but they are loam or clay loam glacial till or silty glacial drift where all of the sand and gravel has been removed. Mounds of mixed cobbly, stony, and loamy overburden are on the edges of the areas. The bottoms and sides support little or no vegetation during periods when the pits are used.

Included with the gravel pits in mapping are small areas of Wabek soils. These soils have gravelly sand at a depth of 7 to 14 inches. They support plants.

Most gravel pits can be used only as a source of sand and gravel for construction purposes. Some provide limited wildlife habitat. Abandoned gravel pits can be restored to range, tame pasture, or cropland if reclamation measures are applied. These measures include shaping the areas and using the mounds of overburden material as topsoil dressing. Applying fertilizer as needed helps to establish range or pasture.

The capability subclass is VIIIs; no range site is assigned.

100—Parnell silty clay loam, ponded. This deep, very poorly drained, level soil is in depressions and along the edges of lakes in the uplands. In most years it is ponded by water that is seldom more than 2 feet deep during the growing season. Areas are circular or long and narrow and 5 to 150 acres in size.

Typically, the surface layer is dark gray silty clay loam about 7 inches thick. The subsoil is dark gray and gray, firm silty clay about 38 inches thick. The underlying material to a depth of 60 inches is gray silty clay. In places, the subsoil contains less clay, and lime is at or near the surface.

Included with this soil in mapping are small areas of the poorly drained Vallers soils. These soils make up less than 10 percent of any one mapped area. They are calcareous throughout. They are at the edges of the mapped areas.

The content of organic matter and fertility are high in the Parnell soil. Permeability is slow. Available water capacity is moderate or high. Runoff is ponded. During wet periods the water table is as much as 2 feet above the surface. During dry periods it is as much as 2 feet below the surface.

This soil is well suited to wetland wildlife habitat. Most areas are used for this purpose (fig. 8). Deer, pheasants, and other wildlife frequent the margins of these areas. The native vegetation, which is cattails, rushes, and sedges, provides food and cover for a variety of waterfowl and wetland birds. Ducks nest on the drier adjacent sites and raise their broods in the ponded areas. Geese and other waterfowl use these areas as periodic resting and feeding sites during migration. The vegetated areas commonly are interspersed with small bodies of open water.

Because it is wet, this soil is poorly suited to range and generally is unsuitable for cultivated crops, tame pasture and hay, windbreaks and environmental plantings, building site development, and septic tank absorption fields.

The capability subclass is VIIIw; no range site is assigned.

prime farmland

Prime farmland is one of several kinds of important farmlands defined by the U. S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U. S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U. S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops.

Figure 8.—An area of Parnell silty clay loam, ponded, used as habitat for wetland wildlife.

Prime farmland has an adequate and dependable supply of moisture. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 11,640 acres in McPherson County, or nearly 2 percent of the total acreage, meets the requirements for prime farmland. It occurs as scattered areas throughout the county. The main crops are corn, grain sorghum, and alfalfa.

The map units that are considered prime farmland are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units."

The map units that meet the requirements for prime farmland are:

5A—Bowbells loam, 0 to 2 percent slopes
5B—Bowbells loam, 2 to 6 percent slopes
6—Arnegard loam
31—Harmony silty clay loam
64—Grassna silt loam
65—Grail silty clay loam (where flooded once or less during the growing season)

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; and as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

George W. Leibel, district conservationist, Soil Conservation Service, helped write this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About one-half of the acreage in McPherson County is used for cultivated crops or for tame pasture and hay (*3*). The major crops are alfalfa, spring wheat, oats, and flax. Barley, corn, sunflowers, and rye also are grown. Alfalfa is harvested mainly for hay, spring wheat is grown as a cash crop, oats is grown as a cash crop and as livestock feed, and corn is harvested for both silage and grain.

The potential of the soils in McPherson County for increased crop production is good. About 45,000 acres of potentially good cropland is currently used as range, 12,000 acres as pasture, and 55,000 acres as tame hayland. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

Soil erosion is the major problem on about 65 percent of the cropland, hayland, and pasture in McPherson County. If the slope is more than 2 percent, erosion is a hazard on Bearpaw, Bowdle, Bryant, Mondamin, Temvik, Vida, Williams, and other soils. Lihen and Tally soils also are subject to wind erosion.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils having a claypan subsoil, such as Noonan, and on soils having a thin surface layer, such as Vida and Zahl. Erosion also reduces the productivity on soils that tend to be droughty, such as Bowdle and Lehr. Second, erosion results in the sedimentation of streams and lakes. Controlling erosion minimizes the pollution of streams and lakes by sediment and improves water quality for fish and wildlife, recreation, and municipal use.

A cropping system that includes grasses and legumes and that keeps a plant cover on the surface for extended periods holds soil losses to an amount that will not

reduce the productive capacity of the soils. Leaving crop residue on the surface during the critical erosion period early in spring helps to protect the soil from wind and water erosion. The crop residue also adds organic matter to the soil, improves fertility and tilth, and aids in the retention and absorption of rainfall.

Terraces, diversions, and contour stripcropping help to control erosion on the gently sloping and moderately sloping Bearpaw, Bowdle, Bryant, Mondamin, and Temvik soils. Slopes are so short and irregular that contour farming and terracing are not practical in most areas of the sloping Vida and Williams soils. On these soils a cropping system that keeps a substantial plant cover on the surface is needed to control erosion.

Minimizing tillage and leaving crop residue on the surface increase the infiltration rate and reduce the risks of runoff and erosion. Together with grassed waterways, these practices are suitable on most soils in the survey area.

Wind erosion is a slight to severe hazard on many of the soils in the county. The hazard is especially severe on those soils having a fine sandy loam or loamy fine sand surface layer, such as Lihen, Parshall, and Tally. The soils that have a high content of lime in the surface layer, such as Divide, Hamerly, Vallers, and Zahl, also are highly susceptible to wind erosion. These soils can be damaged in a few hours if winds are strong and the soils are dry and have no plant cover or surface mulch. An adequate plant cover, a cover of crop residue, stripcropping, and a rough surface minimize wind erosion on these soils. Including grasses and legumes in the cropping system, planting windbreaks of suited trees and shrubs, and leaving strips of unharvested crops also are effective in reducing the risk of wind erosion.

Information about the measures that control erosion on each kind of soil is contained in the Technical Guide, available in the local office of the Soil Conservation Service.

Soil drainage is the major management need on the poorly drained Tonka and Vallers soils. Unless artificially drained, these soils are so wet that crops frequently are damaged. Open ditches help to remove excess water if outlets are available. Controlling the runoff on the adjacent slopes also helps to reduce the wetness of these soils.

The moderately well drained Bowbells, Grail, Grassna, and Straw and somewhat poorly drained Hamerly soils on stream terraces, flood plains, flats and in upland swales receive stream overflow and runoff from adjacent uplands. In most years, drainage is adequate and crops benefit from the additional moisture. Artificial drainage is rarely needed on these soils. During wet years, however, spring planting and tillage are delayed.

Soil fertility should be maintained so that optimum yields can be obtained. In soils that have a high content of lime in the surface layer, such as Divide, Hamerly, Regan, and Vallers, the kinds and amounts of fertilizer needed generally differ from the kinds and amounts needed on soils that do not have lime in the surface layer. Including grasses and legumes in the cropping system improves fertility in the soils having a high content of lime. On all soils additions of fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer needed.

Soil tilth affects the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. If tilled when wet, Bearpaw and Mondamin soils tend to be very cloddy when dry. As a result of the cloddiness, preparing a good seedbed is difficult. These soils dry slowly in the spring and cannot be easily tilled. Tilth also is poor in claypan soils, such as Exline and Miranda. Selecting a proper time for tillage, including grasses and legumes in the cropping system, and incorporating crop residue into the soil improve tilth and increase the rate of water intake.

Field crops suited to the soils and climate of the survey area include small grain and row crops. Oats and spring wheat are the main small grain crops. Barley, corn, flax, and rye are grown on a lesser acreage. Sorghum also is grown on a small acreage. These row crops commonly are harvested for silage. The acreage planted to sunflowers is increasing.

All commonly grown and climatically suited crops are suited to deep, well drained or moderately well drained soils, such as Bearpaw, Bowbells, Bryant, Grail, Grassna, Mondamin, Vida, and Williams soils. Bowdle and Lehr soils are better suited to early maturing small grain than to deeper rooted crops, such as corn and alfalfa, because the porous underlying material limits the available water capacity and root penetration. The erosive Lihen, Parshall, and Tally soils also are better suited to small grain, which provides better protection against wind erosion, than to row crops.

Pasture plants best suited to the climate and most of the soils in the survey area include alfalfa, intermediate wheatgrass, and smooth bromegrass. Crested wheatgrass is well suited to soils that tend to be droughty, such as Bowdle and Lehr. Bunch grasses, such as crested wheatgrass, should not be planted in areas where the slope is more than 6 percent because erosion is a hazard. Pubescent wheatgrass is suited to Noonan and other soils that have a dense claypan subsoil. The choice of pasture plants is limited to water tolerant species, such as Garrison creeping foxtail and reed canarygrass, on the poorly drained Heil, Tonka, and Vallers soils and the very poorly drained Parnell soils.

Proper stocking rates, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition. If the pasture is overgrazed, the grasses lose vigor and die and are usually replaced by annual grasses and weeds.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*13*). Only class and subclass are used in this survey. These levels are defined in the following paragraphs. Some survey areas do not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

George W. Leibel, district conservationist, Soil Conservation Service, helped write this section.

About half of the acreage in McPherson County is rangeland (*3*). More than half of the local farm income is derived from the sale of livestock, principally cattle. Cow-calf-steer enterprises are dominant throughout the county. The average size of farms or ranches is 1,090 acres.

The rangeland generally occurs as scattered tracts throughout the county. The soils used as rangeland generally are too steep, too stony, or too thin for cultivated crops. Examples are the steeper phases of Williams, Zahill, and Zahl soils.

On many farms the forage produced on rangeland is supplemented by crop stubble. In winter the native forage commonly is supplemented by protein concentrate. On some ranches the market weight of calves and yearlings is increased by creep feeding.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for many soils in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of wind and water erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The native vegetation in many parts of the county has been greatly depleted by continued excessive use. Much of the acreage that was once mixed prairie is now covered with short grasses and weeds. The amount of forage produced may be less than half of that originally produced. The productivity of the range can be increased by applying management that is effective on specific kinds of soil and range sites.

An adequate plant cover and ground mulch help to control erosion and increase the mositure supply by reducing the runoff rate. If the range is overgrazed, the more desirable tall grasses lose vigor and are replaced by less productive short grasses. Applying measures that prevent overgrazing helps to keep the range in good condition. Crossfencing and properly distributed watering facilities help to obtain a uniform distribution of grazing.

native woods and windbreaks and environmental plantings

George W. Leibel, district conservationist, Soil Conservation Service, helped write this section.

Native trees and shrubs grow on only about 1,000 acres in McPherson County. They generally grow as clumps and thickets in swales or in areas adjacent to drainageways and sloughs, mainly in the north-central part of the county. The early settlers used the native trees and shrubs as fuel and as a food supply. Today, the trees and shrubs are used mainly for wildlife habitat.

Scattered individual plants or clumps of bur oak, common chokecherry, hawthorn, western snowberry, and wild rose are common on the rolling and hilly Vida, Zahill, and Zahl soils in swales in the northeastern part of the Leola Hills and along the drainageways that flow in a southeast direction out of the hills. Cottonwood and willow are on the margins of some sloughs and perennial lakes.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, keep snow from blowing off fields, and provide food and cover for wildlife (fig. 9).

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

Grazing is detrimental to windbreaks and environmental plantings because the livestock compact the soil and remove the lower branches of the trees and shrubs. The compaction retards growth. Removal of the lower branches reduces the effectiveness of the windbreaks. Weeds and insects prevent maximum growth. Clean cultivation and applications of herbicide help to control weeds. Fallowing a year before planting helps to provide a reserve supply of moisture, which is needed before seedlings can be established. On Tally and other soils that are susceptible to wind erosion, the site should be prepared in the spring so that it is not exposed to wind erosion during the winter. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

wildlife habitat

John B. Farley, biologist, Soil Conservation Service, helped write this section.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges and management areas, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, millet, oats, sunflowers, and wheat.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are alfalfa, crested wheatgrass, intermediate wheatgrass, smooth bromegrass, and yellow sweetclover.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are beggarweed, big and little bluestem, blue grama, common sunflower, goldenrod, switchgrass, and western wheatgrass.

Hardwood trees are planted trees and shrubs that produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are American elm, apple, box elder, bur oak, green ash, hackberry, and plains cottonwood. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are American plum, common chokecherry, cotoneaster, honeysuckle, and Russian-olive.

Figure 9.—Field windbreak in an area of Williams-Bowbells loams, 1 to 6 percent slopes.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are cattail, inland saltgrass, prairie cordgrass, reeds, rushes, sedges, smartweed, and wild millet.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas (fig.10). Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, ditches, ponds, and shallow dugouts.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, forbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include eastern cottontail, gray partridge, meadowlark, mourning dove, red fox, ring-necked pheasant, whitetail jackrabbit, and whitetail deer.

Habitat for wetland wildlife consists of marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are beaver, ducks, geese, herons, mink, muskrat, and shore birds.

Habitat for rangeland wildlife consists of areas of native shrubs and herbaceous plants. Wildlife attracted to rangeland include lark bunting, meadowlarks, sharp-tailed grouse, whitetail deer, and whitetail jackrabbit.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 feet.

Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

Figure 10.—An area of water used by wetland wildlife. The water is surrounded by Vida-Williams-Bowbells loams, 2 to 15 percent slopes.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 10 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons (aerobic) are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should

have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers

of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan,

large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 16.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 16.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K in this county range from 0.10 to 0.43. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are

moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

engineering test data

Table 16 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series. The soil samples were analyzed by the South Dakota Department of Transportation, Division of Highways.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*14*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed Typic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*12*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*14*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Arnegard series

The Arnegard series consists of deep, well drained soils formed in loamy alluvium on lake plains. Permeability is moderate. Slopes range from 0 to 2 percent.

The Arnegard soils in this county have lower chroma in the A horizon and the upper part of the B horizon than is defined as the range for the Arnegard series. This difference, however, does not alter the use or behavior of the soils.

Arnegard soils are similar to Bowbells, Grassna, and Roseglen soils and commonly are near Harmony and

Rentill soils. Bowbells and Harmony soils have an argillic horizon. Harmony soils contain more clay in the subsoil and underlying material than the Arnegard soils. Also, they are slightly lower on the landscape. Grassna soils contain more silt throughout and less sand in the subsoil than the Arnegard soils. Rentill soils have free carbonates in the surface layer. Their position on the landscape is similar to that of the Arnegard soils. Roseglen soils are moderately well drained.

Typical pedon of Arnegard loam, 1,490 feet north and 80 feet west of the southeast corner of sec. 13, T. 128 N., R. 67 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; common very fine roots; slightly acid; abrupt smooth boundary.

B21—9 to 13 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; common very fine roots; neutral; clear wavy boundary.

B22—13 to 17 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak coarse and medium subangular blocky; hard, friable; common very fine roots; neutral; clear wavy boundary.

B3ca—17 to 22 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium subangular blocky structure; hard, friable; common very fine roots; common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C1ca—22 to 32 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; slightly hard, friable; few very fine roots; many medium and fine accumulations of carbonate; strong effervescence; mildly alkaline; abrupt smooth boundary.

C2—32 to 36 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; common fine accumulations and striations of carbonate; strong effervescence; moderately alkaline; abrupt smooth boundary.

C3—36 to 60 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 32 inches. The depth to free carbonates and the thickness of the mollic epipedon range from 16 to 32 inches.

The A horizon has value of 3 or 4 (2 or 3 moist). It is 8 to 12 inches thick and is loam or silt loam. The B2 horizon has value of 4 or 5 (2 to 4 moist) and chroma of 1 or 2. It is loam or silt loam. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is loam, fine sandy loam, or clay loam and is mildly alkaline or moderately alkaline.

Bearden series

The Bearden series consists of deep, somewhat poorly drained soils formed in glacial lake sediments in swales and basins. Permeability is moderately slow. Slopes are less than 1 percent.

The Bearden soils in this county have a grayer ACca horizon than is defined as the range for the Bearden series. This difference, however, does not alter the use or behavior of the soils.

Bearden soils are similar to Hamerly soils and commonly are near Arnegard, Harmony, Regan, and Rentill soils. Arnegard soils are leached of carbonates to a greater depth than the Bearden soils. Hamerly soils contain more sand throughout and less silt in the control section than the Bearden soils. Harmony soils contain more clay in the subsoil than the Bearden soils. Regan soils are poorly drained and very poorly drained. They are on the lowest part of the landscape. Rentill soils are well drained. Arnegard, Harmony, and Rentill soils are slightly higher on the landscape than the Bearden soils.

Typical pedon of Bearden silt loam, 800 feet south and 950 feet east of the northwest corner of sec. 24, T. 128 N., R. 67 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable; common medium and many fine and very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—6 to 12 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; moderate medium and fine subangular blocky structure parting to weak fine granular; slightly hard, friable; common medium and many fine roots; strong effervescence; mildly alkaline; gradual wavy boundary.

ACca—12 to 15 inches; gray (10YR 5/1 and 6/1) silt loam, dark gray (10YR 4/1) and very dark gray (10YR 3/1) moist; moderate medium and fine subangular blocky structure; slightly hard, friable; common fine and very fine roots; violent effervescence; moderately alkaline; clear irregular boundary.

C1ca—15 to 33 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; common fine and very fine roots; violent effervescence; moderately alkaline; clear wavy boundary.

C2—33 to 60 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct brownish yellow (10YR 6/6) mottles; massive; slightly hard, very friable; few very fine

roots; common fine accumulations of carbonate; strong effervescence; moderately alkaline.

The mollic epipedon ranges from 7 to 16 inches in thickness. The A horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 or 3 moist). It is silt loam, loam, or silty clay loam and is 6 to 14 inches thick. Some pedons do not have an ACca horizon. The Cca horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is silt loam or silty clay loam. The content of calcium carbonate in this horizon is 15 to more than 30 percent. The C2 horizon has few to many, faint to prominent mottles. It is clay loam, silt loam, or silty clay loam. Also, thin strata of sandy loam and silty clay are in some pedons.

Bearpaw series

The Bearpaw series consists of deep, well drained soils formed in glacial till on uplands. Permeability is moderately slow in the subsoil and slow in the underlying material. Slopes range from 0 to 9 percent.

Bearpaw soils are similar to Mondamin soils and commonly are near Cavour, Grail, Greenway, and Williams soils. Cavour soils have a natric horizon. They are in small pits and depressions. Grail soils have a mollic epipedon that is more than 16 inches thick. They are in swales. Greenway soils contain less clay in the upper part of the subsoil than the Bearpaw soils. Mondamin soils formed in silty sediments. Williams soils contain less clay in the subsoil and underlying material than the Bearpaw soils. Greenway, Mondamin, and Williams soils are in positions on the landscape similar to those of the Bearpaw soils.

Typical pedon of Bearpaw loam, in an area of Bearpaw-Greenway loams, 0 to 3 percent slopes, 500 feet north and 81 feet west of the southeast corner of sec. 27, T. 128 N., R. 72 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and fine subangular blocky structure parting to weak fine granular; slightly hard, friable; slightly acid; abrupt smooth boundary.

B21t—5 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse and medium prismatic structure parting to moderate fine and very fine subangular blocky; hard, firm, sticky and plastic; common fine pores; shiny films on faces of peds; neutral; clear smooth boundary.

B22t—8 to 14 inches; grayish brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) crushing to dark grayish brown (2.5Y 4/2) moist; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; very hard, firm, sticky and plastic; common fine pores; shiny films on faces of peds; neutral; clear smooth boundary.

B3ca—14 to 20 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to medium and fine subangular blocky; very hard, firm, sticky and plastic; common fine pores; patchy shiny films on faces of peds; common medium and fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1ca—20 to 42 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, sticky and plastic; few fine prominent dark brown (7.5YR 4/4) and few fine distinct yellowish brown (10YR 5/6) iron stains; many medium and fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 28 inches. The depth to free carbonates ranges from 10 to 18 inches. The mollic epipedon ranges from 8 to 12 inches in thickness.

The A horizon has value of 3 or 4 (2 or 3 moist). It is loam or clay loam and is 2 to 5 inches thick. The B2t horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. The content of clay ranges from 35 to 50 percent in this horizon. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3.

Bowbells series

The Bowbells series consists of deep, well drained and moderately well drained soils formed in loamy alluvium and in glacial till in swales on uplands. Permeability is moderate in the subsoil and moderately slow in the underlying material. Slopes range from 0 to 6 percent.

The Bowbells soils in this county have lower chroma in the A horizon than is definitive for the Bowbells series. This difference, however, does not alter the use or behavior of the soils.

Bowbells soils are similar to Arnegard and Grassna soils and commonly are near Tonka, Vida, and Williams soils. Arnegard and Grassna soils do not have an argillic horizon. Tonka soils are poorly drained and are in depressions. Vida and Williams soils have a mollic epipedon that is less than 16 inches thick. They are higher on the landscape than the Bowbells soils.

Typical pedon of Bowbells loam, in an area of Williams-Bowbells loams, 1 to 6 percent slopes, 996 feet west and 120 feet south of the northeast corner of sec. 35, T. 127 N., R. 69 W.

A1—0 to 11 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium prismatic and

subangular blocky structure parting to moderate fine granular; slightly hard, friable; many fine and very fine roots; many fine pores; neutral; clear wavy boundary.

B21t—11 to 18 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; common very fine roots; common fine pores; thin shiny films on faces of peds; common tongues (1/4 to 1 inch wide), dark gray (10YR 4/1) and very dark gray (10YR 3/1) moist; neutral; gradual wavy boundary.

B22t—18 to 25 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; common very fine roots; common fine pores; thin shiny films on faces of peds; few tongues (1/4 to 1 inch wide), dark grayish brown (10YR 4/2) and very dark brown (10YR 2/2) moist; neutral; clear wavy boundary.

C1ca—25 to 36 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct yellowish brown (10YR 5/6) and light gray (10YR 7/1) and few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; hard, friable; many fine and medium accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—36 to 53 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common medium and fine distinct yellowish brown (10YR 5/6) and light gray (10YR 7/1) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, firm; common fine and few medium accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—53 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common medium and fine distinct yellowish brown (10YR 5/6) and light gray (10YR 7/1) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, firm; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 22 to 36 inches. The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is loam or silt loam. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. It is loam or clay loam. The content of clay in this horizon averages as low as 25 percent in some pedons and as high as 35 percent in others. The C horizon has value of 4 to 6 (4 or 5 moist) and chroma of 2 to 4. It is loam or clay loam.

Bowdle series

The Bowdle series consists of well drained soils on terraces and uplands. These soils are moderately deep over sand and gravel. They formed in glacial outwash. Permeability is moderate in the subsoil and rapid in the underlying material. Slopes range from 0 to 6 percent.

Bowdle soils commonly are near Divide, Lehr, and Wabek soils. Divide soils have a calcic horizon. They are slightly lower on the landscape than the Bowdle soils. Lehr and Wabek soils have gravelly sand within a depth of 20 inches. They are higher on the landscape than the Bowdle soils.

Typical pedon of Bowdle loam, 0 to 3 percent slopes, 830 feet south and 55 feet west of the northeast corner of sec. 4, T. 125 N., R. 73 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; common fine roots; neutral; abrupt smooth boundary.

B21—7 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse and medium prismatic structure parting to weak coarse and medium subangular blocky; hard, friable; few fine roots; neutral; clear wavy boundary.

B22—14 to 22 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse and medium prismatic structure parting to weak medium subangular blocky; hard, friable; neutral; gradual wavy boundary.

IIC1—22 to 26 inches; multicolored gravelly sandy loam; single grain; loose; slight effervescence; mildly alkaline; clear wavy boundary.

IIC2—26 to 60 inches; multicolored gravelly sand; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 14 to 32 inches. The depth to gravelly material ranges from 20 to 40 inches. The mollic epipedon ranges from 16 to 32 inches in thickness.

The A horizon has value of 3 or 4 (2 or 3 moist). It is silt loam or loam and is 4 to 8 inches thick. The B horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 or 3 moist). The content of clay in this horizon averages as low as 18 percent in some pedons and as high as 25 percent in others. Some pedons have a B3 horizon. In some pedons the C horizon is loam, gravelly loam, or sandy loam and has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4.

Brantford series

The Brantford series consists of well drained soils on terraces. These soils are shallow over gravelly sand. They formed in glacial outwash. Permeability is moderate in the subsoil and very rapid in the underlying material. Slopes range from 0 to 3 percent.

Brantford soils are similar to Lehr soils and commonly are near Harriet, Miranda, and Ranslo soils. Lehr soils do not have shale in the underlying gravelly sand and have higher chroma in the A horizon than the Brantford soils. Harriet, Miranda, and Ranslo soils have a natric horizon. Harriet and Ranslo soils are on flood plains, and Miranda soils are in low areas on uplands.

Typical pedon of Brantford loam, 2,550 feet east and 75 feet south of the northwest corner of sec. 28, T. 126 N., R. 66 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium and fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

B21—7 to 13 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common fine roots; common fine pores; neutral; gradual wavy boundary.

B22—13 to 16 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; common fine roots; few fine pores; neutral; clear wavy boundary.

IIC1—16 to 23 inches; dark grayish brown (2.5Y 4/2) gravelly sand, very dark grayish brown (2.5Y 3/2) moist; single grain; loose; few roots in the upper part; about 35 percent shale fragments by volume; mildly alkaline; gradual wavy boundary.

IIC2—23 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly sand, very dark grayish brown (2.5Y 3/2) moist; dark gray (N 4/0) shale chips; single grain; loose; about 50 percent shale fragments; slight effervescence; mildly alkaline.

The thickness of the solum, or the depth to gravelly sand, ranges from 10 to 20 inches. The mollic epipedon ranges from 7 to 16 inches in thickness.

The A horizon has value of 3 or 4 (2 or 3 moist). It is loam or clay loam and is 4 to 10 inches thick. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 to 3. It is loam or clay loam. The content of clay in this horizon averages as low as 18 percent in some pedons and as high as 25 percent in others. The content of shale fragments in the IIC horizon is, by volume, 35 percent or more.

Bryant series

The Bryant series consists of deep, well drained soils formed in silty and loamy glacial drift on uplands. Permeability is moderate. Slopes range from 0 to 9 percent.

Bryant soils are similar to Temvik soils and commonly are near Grassna, Mondamin, Temvik, and Williams soils. Grassna soils have a mollic epipedon that is more than 16 inches thick. They are in swales. Mondamin soils contain more clay in the subsoil than the Bryant soils. Temvik soils are 20 to 40 inches deep over glacial till. Williams soils have an argillic horizon. Mondamin, Temvik, and Williams soils are in positions on the landscape similar to those of the Bryant soils.

Typical pedon of Bryant silt loam, in an area of Bryant-Grassna silt loams, 1 to 6 percent slopes, 650 feet west and 178 feet north of the southeast corner of sec. 18, T. 125 N., R. 73 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable; common fine roots; slightly acid; abrupt smooth boundary.

B2—7 to 15 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; few fine roots; neutral; clear wavy boundary.

B3ca—15 to 23 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; soft, friable; few fine roots; common fine and medium accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C1ca—23 to 34 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, friable; common medium and fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—34 to 60 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, friable; common fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 11 to 30 inches. The depth to free carbonates ranges from 11 to 24 inches. The mollic epipedon ranges from 7 to 16 inches in thickness.

The A horizon has value of 4 or 5 (2 or 3 moist). It is silt loam or loam and is 5 to 8 inches thick. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is silt loam, loam, or silty clay loam. The content of clay in this horizon averages as low as 18 percent in some pedons and as high as 28 percent in others. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is dominantly loam, silt loam, or silty clay loam. In some pedons, however, it has thin strata of very fine sand or fine sand, and in others loam or clay loam glacial till is at a depth of 40 to 60 inches.

Cavour series

The Cavour series consists of deep, moderately well drained soils formed in loamy and clayey glacial till on uplands. Permeability is slow or very slow in the subsoil and moderately slow or slow in the underlying material. Slopes range from 0 to 5 percent.

Cavour soils are similar to Noonan soils and commonly are near Cresbard, Heil, and Miranda soils. Cresbard soils do not have columnar structure in the B2t horizon. They are in positions on the landscape similar to those of the Cavour soils. Heil soils are poorly drained. They are in depressions. Miranda soils have salt crystals within a depth of 16 inches. They are in small pits and depressions. Noonan soils contain more sand throughout and less clay in the subsoil than the Cavour soils.

Typical pedon of Cavour loam, in an area of Cavour-Miranda loams, 1 to 5 percent slopes, 1,056 feet east and 300 feet north of the southwest corner of sec. 15, T. 128 N., R. 66 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium granular structure; soft, friable; neutral; abrupt smooth boundary.

A12—7 to 9 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate fine and medium granular structure; soft, friable; slightly acid; clear smooth boundary.

A2—9 to 11 inches; gray (10YR 6/1) loam, very dark gray (10YR 3/1) moist; weak medium platy and weak medium subangular blocky structure; soft, friable; slightly acid; abrupt smooth boundary.

B21t—11 to 14 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong fine columnar structure parting to moderate fine and medium blocky; very hard, firm, sticky and plastic; thin continuous gray (10YR 6/1) coatings on the tops of columns; shiny films on faces of peds; neutral; clear smooth boundary.

B22t—14 to 21 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak fine prismatic structure parting to strong fine blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; neutral; clear smooth boundary.

B23t—21 to 27 inches; dark gray (5Y 4/1) clay loam, very dark gray (5Y 3/1) moist; moderate fine blocky structure; extremely hard, firm, sticky and plastic; mildly alkaline; gradual wavy boundary.

B3sa—27 to 32 inches; olive gray (5Y 5/2) clay loam, olive gray (5Y 4/2) moist; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few fine threads of salt; mildly alkaline; gradual wavy boundary.

Csacs—32 to 60 inches; light olive gray (5Y 6/2) clay loam, olive gray (5Y 5/2) moist; common fine distinct gray (10YR 5/1) and yellowish brown (10YR 5/8) mottles; massive; hard, firm, sticky and plastic; many fine and medium threads of salt; few fine nests of gypsum; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 38 inches. The depth to free carbonates ranges from 14 to 35 inches. The depth to accumulations of gypsum and other salts ranges from 16 to 30 inches.

The Ap or A1 horizon has value of 3 to 5 (2 or 3 moist). It is loam or silt loam. The A2 horizon has value of 5 to 7 (3 or 4 moist) and chroma of 1 or 2. The A horizon is slightly acid or neutral. The B2t horizon has hue of 10YR, 2.5YR, or 5YR, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. It is silty clay, clay loam, or clay. The content of clay in this horizon averages as low as 35 percent in some pedons and as high as 50 percent in others. Reaction ranges from neutral to moderately alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is moderately alkaline or strongly alkaline.

Cresbard series

The Cresbard series consists of deep, moderately well drained soils formed in loamy glacial till on uplands. Permeability is slow or moderately slow. Slopes range from 0 to 3 percent.

Cresbard soils are similar to Niobell soils and commonly are near Cavour, Heil, and Miranda soils. Cavour soils have columnar structure in the B21t horizon. They are in positions on the landscape similar to those of the Cresbard soils. Heil soils are poorly drained and are in depressions. Miranda soils have visible salt crystals within a depth of 16 inches. They are in small pits and depressions. Niobell soils contain more sand throughout and less clay in the subsoil than the Cresbard soils.

Typical pedon of Cresbard loam, in an area of Cresbard-Cavour loams, 77 feet north and 18 feet west of the southeast corner of sec. 16, T. 128 N., R. 66 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable; neutral; abrupt smooth boundary.

A2—7 to 10 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; slightly hard, friable; slightly acid; clear wavy boundary.

B&A—10 to 12 inches; dark grayish brown (10YR 4/2) clay loam (B), very dark brown (10YR 2/2) moist; light brownish gray (10YR 6/2) coatings of very fine sand on faces of peds (A), very dark grayish brown (10YR 3/2) moist; moderate fine blocky structure; hard, friable; neutral; clear wavy boundary.

B21t—12 to 20 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium

prismatic structure parting to strong fine blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; neutral; abrupt smooth boundary.

B22tsa—20 to 26 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; common fine threads of salt; moderately alkaline; clear smooth boundary.

C1cacs—26 to 37 inches; light brownish gray (2.5Y 6/2) clay loam, olive (5Y 5/3) moist; few fine distinct yellowish brown (10YR 5/8) mottles; massive; very hard, firm, sticky and plastic; few fine threads of salt; common fine nests of gypsum; common fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

C2cs—37 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, olive (5Y 5/3) moist; common fine and medium distinct gray (10YR 5/1) and few fine distinct yellowish brown (10YR 5/8) mottles; massive; hard, firm, sticky and plastic; common fine nests of gypsum; common fine and medium accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 18 to 40 inches. The Ap horizon has value of 3 or 4 (2 or 3 moist). It is loam or silt loam and is 5 to 10 inches thick. Some pedons do not have an A2 horizon. The B2t horizon has value of 2 to 4 moist and chroma of 1 to 3. It is clay loam or clay. The content of clay in this horizon averages as low as 35 percent in some pedons and as high as 50 percent in others. Some pedons have a B3 horizon. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is loam or clay loam and is mildly alkaline to strongly alkaline.

Divide series

The Divide series consists of somewhat poorly drained soils in glacial melt water channels and on outwash plains and terraces. These soils are moderately deep over gravelly sand. Permeability is moderate in the loamy sediments and rapid or very rapid in the underlying gravelly sand. Slopes range from 0 to 3 percent.

Divide soils are similar to Hamerly and Marysland soils and commonly are near Bowdle, Lehr, Marysland, and Regan soils. The well drained Bowdle and somewhat excessively drained Lehr soils are higher on the landscape than the Divide soils. Hamerly soils formed in clay loam glacial till and do not have a gravelly sand IIC horizon. The poorly drained Marysland and very poorly drained Regan soils are in the outwash channels.

Typical pedon of Divide loam, 2,400 feet north and 300 feet east of the southwest corner of sec. 34, T. 128 N., R. 67 W.

A1—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium granular structure; soft, friable; slight effervescence; moderately alkaline; clear smooth boundary.

C1ca—8 to 30 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; few fine faint yellowish brown (10YR 5/4) mottles; weak thin platy and weak medium and fine subangular blocky structure; soft, friable; violent effervescence; moderately alkaline; clear smooth boundary.

IIC2—30 to 60 inches; multicolored gravelly sand; single grain; loose; slight effervescence; moderately alkaline.

The depth to gravelly sand ranges from 20 to 36 inches. The calcium carbonate equivalent ranges from 15 to 30 percent within a depth of 16 inches.

The A horizon has value of 3 to 5 (2 or 3 moist). It is loam or silt loam and is 7 to 16 inches thick. The Cca horizon has hue of 10YR or 2.5Y, value of 5 to 7 (3 to 5 moist), and chroma of 1 or 2. It is loam or clay loam. The IIC horizon has shale fragments in some pedons. In some pedons loamy glacial till is at a depth of 40 to 60 inches.

Exline series

The Exline series consists of deep, somewhat poorly drained soils formed in lacustrine deposits in microdepressions. Permeability is very slow. Slopes range from 0 to 2 percent.

The Exline soils in this county are a taxadjunct to the Exline series because they are 40 to 60 inches deep over clay loam glacial till. This difference, however, does not alter the use or behavior of the soils.

Exline soils commonly are near the Arnegard, Harmony, and Rentill soils on the slightly higher parts of the landscape. These nearby soils do not have a natric horizon. Also, Arnegard and Rentill soils contain more sand in the subsoil than the Exline soils.

Typical pedon of Exline silt loam, in an area of Exline-Harmony complex, 2,517 feet east and 57 feet north of the southwest corner of sec. 36, T. 128 N., R. 67 W.

A2—0 to 2 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak very thin platy structure parting to weak very fine granular; soft, very friable; many fine and very fine roots along horizontal faces of peds; slightly acid; abrupt smooth boundary.

B21t—2 to 7 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; strong medium columnar structure parting to moderate medium and fine blocky; very hard, very firm, sticky and very plastic; common fine and very fine roots along vertical faces of peds; shiny films on faces of peds; neutral; clear wavy boundary.

B22t—7 to 12 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium

prismatic structure parting to moderate fine and very fine blocky; extremely hard, very firm, sticky and very plastic; few very fine roots; shiny films on faces of peds; few small nests of salt crystals; strong effervescence; moderately alkaline; clear wavy boundary.

B3cacs—12 to 19 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to moderate fine and very fine blocky; hard, very firm, sticky and very plastic; black (10YR 2/1), moist, coatings on faces of peds; many fine nests of gypsum; common small nests of salt crystals; few fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1cacs—19 to 30 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 4/2) moist; weak medium subangular blocky structure; hard, very firm, sticky and very plastic; common medium and fine nests of gypsum; few small nests of salt crystals; few fine accumulations of carbonate; strong effervescence; strongly alkaline; gradual wavy boundary.

C2cacs—30 to 43 inches; olive gray (5Y 5/2) silty clay loam, olive gray (5Y 4/2) moist; massive; hard, firm, very sticky and very plastic; common medium and fine nests of gypsum; few fine accumulations of carbonate; strong effervescence; strongly alkaline; gradual wavy boundary.

IIC3—43 to 55 inches; olive gray (5Y 5/2) clay loam, olive gray (5Y 4/2) moist; massive; very hard, firm, sticky and plastic; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC4—55 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish red (5YR 5/8) mottles; massive; extremely hard, firm, sticky and plastic; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 24 inches. Gypsum and other salts are at a depth of 6 to 16 inches. The depth to free carbonates ranges from 8 to 19 inches.

Some pedons have an A1 horizon. The A2 horizon has value of 5 or 6 (3 or 4 moist). It is silt loam or silty clay loam and is slightly acid or neutral. In cultivated areas it is mixed with the B2t horizon. The B2t horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is silty clay or clay. It ranges from neutral to moderately alkaline. The C horizon has value of 5 to 7 (3 to 5 moist) and chroma of 1 to 4. It is moderately alkaline or strongly alkaline.

Grail series

The Grail series consists of deep, moderately well drained soils formed in local alluvium in broad swales on uplands. Permeability is moderately slow. Slopes range from 0 to 3 percent.

The Grail soils in this county have lower chroma in the A and B horizons than is defined as the range for the Grail series. This difference, however, does not alter the use or behavior of the soils.

Grail soils are similar to Harmony soils and commonly are near Bearpaw, Bowbells, and Mondamin soils. Bearpaw and Mondamin soils have a mollic epipedon that is less than 16 inches thick. They are higher on the landscape than the Grail soils. Bowbells soils contain more sand in the subsoil than the Grail soils. Their position on the landscape is similar to that of the Grail soils. Harmony soils formed in lacustrine sediments on lake plains.

Typical pedon of Grail silty clay loam, 720 feet north and 44 feet east of the southwest corner of sec. 36, T. 127 N., R. 69 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak coarse subangular blocky structure; hard, friable; slightly acid; abrupt smooth boundary.

B2t—6 to 18 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak medium prismatic structure parting to moderate fine blocky; extremely hard, firm, sticky and plastic; shiny films on faces of peds; neutral; clear wavy boundary.

B3—18 to 30 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; weak medium prismatic structure parting to weak moderate subangular blocky; extremely hard, firm, sticky and plastic; dark gray (10YR 4/1) tongues, black (10YR 2/1) moist; slight effervescence; neutral; gradual wavy boundary.

C1ca—30 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; extremely hard, firm, sticky and plastic; dark gray (10YR 4/1) tongues in the upper part, black (10YR 2/1) moist; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—42 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, firm, sticky and plastic; common fine accumulations of carbonate; few fine nests of gypsum; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to more than 42 inches. The mollic epipedon is more than 16 inches thick.

The A horizon has value of 2 or 3 moist and chroma of 1 or 2. It is silt loam or silty clay loam. The B2t horizon has hue of 10YR or 2.5Y, value of 2 to 4 moist, and chroma of 1 or 2. It is silty clay loam or silty clay. The content of clay in this horizon averages as low as 35 percent in some pedons and as high as 45 percent in others. The C horizon has hue of 2.5Y or 5Y. It is silty clay loam, silty clay, or clay loam. It is mildly alkaline or moderately alkaline.

Grassna series

The Grassna series consists of deep, moderately well drained soils formed in silty alluvium in swales on uplands. Permeability is moderate. Slopes range from 0 to 3 percent.

When moist, the Grassna soils in this county have lower chroma in the A horizon than is defined as the range for the Grassna series. Also, they have lower value in the B horizon. These differences, however, do not alter the use or behavior of the soils.

Grassna soils are similar to Arnegard and Bowbells soils and commonly are near Bryant, Temvik, and Tonka soils. Arnegard soils contain more sand between depths of 10 and 40 inches than the Grassna soils. Bowbells soils contain more sand throughout and less silt in the subsoil than the Grassna soils. Bryant and Temvik soils have a mollic epipedon that is less than 16 inches thick. They are higher on the landscape than the Grassna soils. Also, Temvik soils are 20 to 40 inches deep over clay loam glacial till. Tonka soils are poorly drained. They are in depressions.

Typical pedon of Grassna silt loam, in an area of Bryant-Grassna silt loams, 1 to 6 percent slopes, 675 feet east and 525 feet south of the northwest corner of sec. 16, T. 125 N., R. 73 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak medium and fine subangular blocky structure parting to weak fine granular; slightly hard, friable; many fine and very fine roots; neutral; abrupt smooth boundary.

A12—7 to 16 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; many fine and very fine roots; neutral; gradual wavy boundary.

B21—16 to 27 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common fine and very fine roots; neutral; gradual wavy boundary.

B22—27 to 34 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable; few very fine roots; neutral; clear wavy boundary.

C1ca—34 to 48 inches; light gray (2.5Y 7/2) silt loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable; few fine accumulations of carbonate; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—48 to 60 inches; light gray (2.5Y 7/2) silt loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable; common fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 50 inches. The content of clay in the control section averages as low as 18 percent in some pedons and as high as 26 percent in others. The mollic epipedon ranges from 16 to 40 inches in thickness.

The A horizon has value of 3 to 5 (2 or 3 moist). It is silt loam or silty clay loam and is 7 to 18 inches thick. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 to 4 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. The C horizon has value of 6 or 7 (4 to 6 moist) and chroma of 2 to 4.

Greenway series

The Greenway series consists of deep, well drained soils formed in loamy sediments and in the underlying compact glacial till. These soils are on uplands. They are moderately permeable in the upper part and slowly permeable in the lower part. Slopes range from 0 to 6 percent.

Greenway soils are similar to Williams soils and commonly are near Bearpaw and Williams soils. Bearpaw soils contain more clay in the upper part than the Greenway soils. Williams soils are in positions on the landscape similar to those of the Greenway soils. Their underlying material is not so dense and compact as that of the Greenway soils.

Typical pedon of Greenway loam, in an area of Bearpaw-Greenway loams, 0 to 3 percent slopes, 1,690 feet west and 1,000 feet north of the southeast corner of sec. 27, T. 128 N., R. 72 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak very fine granular; slightly hard, friable; medium acid; abrupt smooth boundary.

B21t—8 to 12 inches; dark grayish brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; thin shiny films on faces of peds; slightly acid; clear smooth boundary.

B22t—12 to 16 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; very dark grayish brown (10YR 3/2), moist, coatings on faces of peds; moderate medium prismatic structure parting to weak coarse and medium subangular blocky; hard, friable; thin shiny films on faces of peds; slightly acid; clear smooth boundary.

B23t—16 to 19 inches; light olive brown (2.5Y 5/4) sandy loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; thin patchy coatings on faces of peds; slightly acid; clear wavy boundary.

IIB24t—19 to 24 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist;

moderate medium prismatic structure parting to weak coarse subangular blocky; very hard, firm, sticky and plastic; common olive brown (2.5Y 4/4) tongues, dark yellowish brown (10YR 4/6) moist; thin continuous shiny films on faces of peds; neutral; gradual wavy boundary.

IIB3ca—24 to 33 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine distinct reddish brown (5YR 4/4) mottles; weak medium prismatic structure parting to weak coarse subangular blocky; hard, firm, sticky and plastic; thin continuous shiny films on faces of peds; medium and coarse accumulations of carbonate; violent effervescence; mildly alkaline; gradual wavy boundary.

IIC1ca—33 to 41 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine distinct reddish brown (5YR 4/4) mottles; massive; hard, firm, sticky and plastic; many medium and coarse accumulations of carbonate; violent effervescence; moderately alkaline; gradual wavy boundary.

IIC2—41 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct reddish brown (5YR 4/4) mottles; massive; hard, firm, sticky and plastic; few fine and medium accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 45 inches. The depth to free carbonates ranges from 10 to 30 inches. The mollic epipedon ranges from 10 to 16 inches in thickness. The depth to firm glacial till is 15 to 25 inches.

The A horizon has value of 3 or 4 (2 or 3 moist). It is loam or silt loam. The B2t horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. The IIB2t horizon has hue of 2.5Y or 5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. It is clay loam or clay that averages more than 35 percent clay. The IIC horizon has hue of 2.5Y or 5Y, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4.

Hamerly series

The Hamerly series consists of deep, somewhat poorly drained soils formed in glacial till on uplands. Permeability is moderate in the upper part of the soils and moderately slow in the lower part. Slopes range from 0 to 3 percent.

Hamerly soils are similar to Bearden and Divide soils and commonly are near Parnell, Vallers, and Williams soils. Bearden soils contain more silt throughout and less sand between depths of 10 and 40 inches than the Hamerly soils. Divide soils are 20 to 36 inches deep over gravelly sand. Parnell soils are very poorly drained, and Vallers soils are poorly drained. Parnell soils are in depressions, and Vallers soils are in depressions and drainageways. The well drained Williams soils are higher on the landscape than the Hamerly soils.

Typical pedon of Hamerly loam, 625 feet west and 80 feet south of the northeast corner of sec. 19, T. 128 N., R. 69 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; soft, friable; many fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 13 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak coarse subangular blocky structure parting to weak fine and medium subangular blocky; soft, friable; common fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

C1ca—13 to 18 inches; gray (10YR 6/1) clay loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

C2ca—18 to 34 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable; common fine accumulations of carbonate; violent effervescence; mildly alkaline; gradual wavy boundary.

C3—34 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; common fine distinct gray (10YR 6/1) and brownish yellow (10YR 6/6) mottles; massive; hard, firm; strong effervescence; mildly alkaline.

Reaction ranges from neutral to moderately alkaline throughout the soils. In some areas that support native grass, the upper few inches is leached of carbonates. The calcium carbonate equivalent ranges from 18 to 30 percent in the part of the C horizon within a depth of 16 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is loam or silt loam and is 5 to 15 inches thick. Some pedons do not have an A12 horizon. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 moist, and chroma of 1 to 4. It is loam or clay loam.

Harmony series

The Harmony series consists of deep, moderately well drained soils formed in lacustrine deposits on lake plains. Permeability is moderately slow. Slopes range from 0 to 2 percent.

Harmony soils are similar to Grail soils and commonly are near Arnegard, Exline, and Rentill soils. Arnegard soils contain more sand throughout and less clay in the subsoil than the Harmony soils. They are slightly higher on the landscape than the Harmony soils. Exline soils have a natric horizon. They are in small depressions and pits. Grail soils formed in local alluvium. Rentill soils

contain more sand throughout and less clay in the upper part than the Harmony soils. They are higher on the landscape than the Harmony soils.

Typical pedon of Harmony silty clay loam, 393 feet north and 25 feet west of the southeast corner of sec. 13, T. 128 N., R. 67 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak very fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

B2t—8 to 17 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium and fine blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; neutral; clear wavy boundary.

B3—17 to 23 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate fine blocky; hard, friable, sticky and plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline; clear wavy boundary.

C1cacs—23 to 36 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine blocky structure; hard, friable, sticky and plastic; few fine accumulations of carbonate; common fine nests of gypsum; few fine nests of salt crystals; strong effervescence; mildly alkaline; gradual wavy boundary.

C2ca—36 to 45 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/4) mottles; massive; hard, friable, sticky and plastic; few fine accumulations of carbonate; few fine nests of gypsum and salt crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C3ca—45 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/4) mottles; massive; hard, friable, sticky and plastic; few medium and many fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 35 inches. The mollic epipedon ranges from 16 to 30 inches in thickness. The depth to free carbonates ranges from 16 to 30 inches.

The A horizon has value of 3 or 4 (2 or 3 moist). It is silt loam or silty clay loam and is 8 to 12 inches thick. It is slightly acid or neutral. The B2t horizon has value of 4 to 6 (3 or 4 moist) and chroma of 1 or 2. It is silty clay loam or silty clay that averages as low as 35 percent clay in some pedons and as high as 50 percent clay in others. It is neutral or mildly alkaline. The C horizon has value of 6 or 7 (4 or 5 moist) and chroma of 2 or 3. It is silt loam, silty clay loam, or silty clay. It is mildly alkaline or moderately alkaline. Some pedons have a clay loam IIC horizon at a depth of 36 to 60 inches.

Harriet series

The Harriet series consists of deep, poorly drained soils formed in alluvium on flood plains. Permeability is very slow. Slopes are less than 1 percent.

Harriet soils are similar to Heil soils and commonly are near Miranda, Niobell, Noonan, and Ranslo soils. Carbonates are leached deeper in the Heil soils than in the Harriet soils. Miranda, Niobell, and Noonan soils contain less clay in the subsoil than the Harriet soils. They are on glacial till uplands. Ranslo soils are in positions on the landscape similar to those of the Harriet soils. Their surface soil is thicker than that of the Harriet soils.

Typical pedon of Harriet loam, 237 feet south and 180 feet west of the northeast corner of sec. 24, T. 126 N., R. 67 W.

A2—0 to 2 inches; gray (10YR 6/1) loam, very dark gray (10YR 3/1) moist; weak very fine granular structure; soft, very friable; common very fine roots; mildly alkaline; abrupt smooth boundary.

B2t—2 to 7 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; strong medium columnar structure parting to medium fine blocky; very hard, firm, sticky and plastic; gray (10YR 6/1) coatings on the tops of columns and on faces of peds; common very fine roots; shiny films on faces of peds; few fine nests of salt crystals; moderately alkaline; gradual wavy boundary.

B3sa—7 to 15 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate fine and very fine blocky structure; very hard, firm, sticky and plastic; few very fine roots; common fine nests of salt crystals and gypsum; slight effervescence; moderately alkaline; diffuse irregular boundary.

C1ca—15 to 46 inches; light olive gray (5Y 6/2) stratified loam and clay loam, olive gray (5Y 5/2) moist; common medium and fine distinct light olive brown (2.5Y 5/6) mottles; massive; extremely hard, firm, sticky and plastic; gray (10YR 5/1) vertical tongues 1/4 inch to more than 2 inches wide; few fine nests of gypsum; many medium and fine accumulations of carbonate; strong effervescence; strongly alkaline; abrupt smooth boundary.

IIC2—46 to 52 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; slightly hard, very friable; moderately alkaline; gradual wavy boundary.

IIC3—52 to 60 inches; light brownish gray (2.5Y 6/2) gravelly loam, dark olive gray (5Y 3/2) moist; slightly hard, very friable; about 20 percent shale fragments by volume; moderately alkaline.

The thickness of the solum ranges from 10 to 24 inches. Salts typically are at a depth of 4 to 11 inches but are throughout some pedons.

Some pedons have a dark A1 horizon, which is 1 or 2 inches thick. The A2 horizon has value of 5 or 6 (3 or 4

moist). It is loam or silt loam. The B2t horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is clay loam or clay. The content of clay in this horizon averages as low as 35 percent in some pedons and as high as 50 percent in others. Some pedons do not have a B3 horizon. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1 to 3. It has few or common, faint or distinct mottles. It is stratified very fine sandy loam, loam, clay loam, and silty clay. Some pedons do not have strata of coarser textured material below a depth of 30 inches.

Heil series

The Heil series consists of deep, poorly drained soils formed in clayey and loamy alluvium in depressions on uplands. Permeability is very slow. Slopes are less than 1 percent.

Heil soils are similar to Harriet soils and are near Miranda, Nishon, and Williams soils. Harriet soils have free carbonates within a depth of 10 inches. Miranda and Williams soils are on the higher parts of the landscape. Miranda soils contain more sand in the subsoil than the Heil soils. Williams soils are well drained. Nishon soils do not have a mollic epipedon or a natric horizon. Their position on the landscape is similar to that of the Heil soils.

Typical pedon of Heil silt loam, 870 feet north and 150 feet east of the southwest corner of sec. 35, T. 125 N., R. 66 W.

A2—0 to 2 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak thin platy structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

B21t—2 to 7 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong medium columnar structure parting to strong fine and medium blocky; very hard, firm, very sticky and plastic; neutral; gradual smooth boundary.

B22t—7 to 16 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to strong medium blocky; very hard, firm, very sticky and plastic; neutral; clear wavy boundary.

B3ca—16 to 26 inches; gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; moderate medium and fine blocky structure; very hard, firm, sticky and plastic; few fine nests of gypsum; common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C1gca—26 to 33 inches; gray (5Y 6/1) silty clay, dark gray (5Y 4/1) moist; weak medium and fine blocky structure; hard, firm, sticky and plastic; few fine nests of gypsum; common fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2gca—33 to 53 inches; gray (5Y 5/1) clay loam, dark gray (5Y 4/1) moist; common fine and medium distinct light olive brown (2.5Y 5/4 and 5/6) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, firm, sticky and plastic; few fine nests of gypsum; common fine and medium accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C3g—53 to 60 inches; gray (5Y 6/1) clay loam, gray (5Y 5/1) moist; common fine distinct olive yellow (5Y 6/6) and few fine distinct black (2.5Y 2/0) mottles; massive; hard, friable, sticky and plastic; few fine nests of gypsum; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 40 inches. The depth to free carbonates ranges from 15 to 38 inches.

Some pedons have an A1 horizon, which is 1 to 3 inches thick. The A2 horizon has value of 4 to 6 (3 to 5 moist). It is silt loam or silty clay loam and is 1 to 4 inches thick. The B2t horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. It is silty clay or clay. The content of clay in this horizon averages as low as 45 percent in some pedons and as high as 60 percent in others. The C horizon is silty clay, clay, or clay loam.

Kloten series

The Kloten series consists of shallow, well drained soils formed in a thin layer of glacial till over shale on uplands. Permeability is moderate above the shale. Slopes range from 9 to 35 percent.

Kloten soils commonly are near Parshall, Tally, Williams, and Zahl soils. These nearby soils do not have shale within a depth of 20 inches. Parshall and Tally soils are on terraces. Williams and Zahl soils are on the higher parts of the landscape.

Typical pedon of Kloten loam, in an area of Zahl-Kloten loams, 9 to 35 percent slopes, 2,515 feet north and 180 feet east of the southwest corner of sec. 26, T. 128 N., R. 66 W.

A1—0 to 6 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; neutral; clear wavy boundary.

C—6 to 14 inches; gray (5Y 6/1) loam, very dark gray (5Y 3/1) moist; weak coarse and medium subangular blocky structure; hard, friable; few shale chips in the upper part and many in the lower part; neutral; clear wavy boundary.

R—14 to 60 inches; gray (5Y 6/1) shale, very dark gray (5Y 3/1) moist; few plant roots extending to 24 inches in cracks; strong brown (7.5YR 5/6) stains on surfaces of plates.

The depth to shale ranges from 9 to 20 inches. The A horizon has value of 3 to 5 (2 or 3 moist). It is loam or

clay loam and is 4 to 10 inches thick. The C horizon has hue of 5Y or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 1 or 2. It is loam or clay loam. The content of hard shale chips increases with increasing depth. In some pedons it is, by volume, more than 50 percent in the lower part of the C horizon.

Lehr series

The Lehr series consists of somewhat excessively drained soils formed in glacial outwash on outwash plains and terraces. These soils are shallow over gravelly sand. Permeability is moderately rapid in the subsoil and rapid or very rapid in the underlying gravelly sand. Slopes range from 0 to 9 percent.

Lehr soils are similar to Brantford soils and commonly are near Bowdle and Wabek soils. Bowdle soils are 20 to 40 inches deep over gravelly sand. They are on the lower parts of the landscape. In the underlying gravelly sand of the Brantford soils, the content of shale fragments is 35 percent or more. The excessively drained Wabek soils are on the higher convex parts of the landscape. They are 7 to 14 inches deep over gravelly sand.

Typical pedon of Lehr loam, in an area of Lehr-Bowdle loams, 0 to 6 percent slopes, 565 feet west and 140 feet north of the southeast corner of sec. 17, T. 127 N., R. 72 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; common very fine roots; neutral; abrupt smooth boundary.

B21—5 to 9 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common very fine roots; neutral; clear wavy boundary.

B22—9 to 15 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak coarse and medium prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; mildly alkaline; clear wavy boundary.

IIC1ca—15 to 34 inches; multicolored gravelly sand; single grain; loose; thin coatings of carbonate on the underside of pebbles; strong effervescence; mildly alkaline; gradual wavy boundary.

IIC2—34 to 60 inches; multicolored gravelly sand; single grain; loose; slight effervescence; moderately alkaline.

The thickness of the solum, or the depth to gravelly sand, ranges from 14 to 20 inches. The underlying material ranges from poorly sorted to well sorted sand and gravel. Reaction ranges from neutral in the upper horizons to moderately alkaline in the lower horizons.

The A horizon has value of 4 or 5 (2 or 3 moist). It is loam, sandy loam, or silt loam and is 5 to 8 inches thick. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is loam or clay loam. The clay content in this horizon ranges from 18 to 30 percent.

Letcher series

The Letcher series consists of deep, moderately well drained soils formed in loamy alluvial outwash on uplands. Permeability is slow in the subsoil and slow to moderately rapid in the underlying material. Slopes range from 0 to 3 percent.

Letcher soils are similar to Noonan soils and commonly are near Niobell, Parshall, and Tally soils. Niobell and Noonan soils contain more clay in the subsoil than the Letcher soils. They are in positions on the landscape similar to those of the Letcher soils. Parshall and Tally soils do not have a natric horizon. They are slightly higher on the landscape than the Letcher soils.

Typical pedon of Letcher loam, in an area of Letcher-Parshall loams, 0 to 4 percent slopes, 471 feet west and 344 feet north of the southeast corner of sec. 11, T. 126 N., R. 66 W.

A11—0 to 9 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine and very fine granular; slightly hard, very friable; many fine and very fine roots; medium acid; clear smooth boundary.

A12—9 to 15 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine and very fine granular; slightly hard, very friable; many fine and very fine roots; medium acid; clear smooth boundary.

A2—15 to 19 inches; light brownish gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; soft, very friable; common fine and very fine roots; slightly acid; abrupt smooth boundary.

B2t—19 to 25 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; strong very coarse and coarse columnar structure; extremely hard, friable; thin continuous gray (10YR 6/1) coatings on the tops of columns; few very fine roots; very dark gray (10YR 3/1) coatings on faces of peds; mildly alkaline; clear smooth boundary.

B3ca—25 to 33 inches; grayish brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure; very hard, very friable; few medium and fine accumulations of carbonate; slight effervescence; strongly alkaline; clear smooth boundary.

C1ca—33 to 37 inches; grayish brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; few fine accumulations of carbonate; slight effervescence; strongly alkaline; clear smooth boundary.

IIAb—37 to 41 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; soft, friable; few fine accumulations of carbonate; slight effervescence; strongly alkaline; clear smooth boundary.

IIC3—41 to 47 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, friable, sticky and plastic; strong effervescence; strongly alkaline; clear smooth boundary.

IIC4—47 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/8) mottles; massive; hard, firm, very sticky and plastic; many medium accumulations of carbonate; violent effervescence; strongly alkaline.

The thickness of the solum ranges from 19 to 36 inches. The depth to free carbonates ranges from 15 to 25 inches.

The A1 horizon is loam, fine sandy loam, or sandy loam and is 8 to 15 inches thick. The A2 horizon has value of 6 or 7 (3 to 5 moist) and chroma of 1 or 2. It is loamy fine sand, fine sandy loam, or sandy loam and is 1 to 5 inches thick. The A1 and A2 horizons range from strongly acid to mildly alkaline. The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is sandy loam or fine sandy loam. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 1 to 3. It is dominantly sandy loam or loamy sand but in some pedons has thin, finer textured strata. The buried A horizon is loam or sandy loam. Some pedons have glacial till within a depth of 60 inches.

Lihen series

The Lihen series consists of deep, well drained soils formed in fine sand on uplands. Permeability is rapid. Slopes range from 0 to 20 percent.

Lihen soils commonly are near Bryant, Parshall, Tally, Tansem Variant, and Wabek soils. Bryant soils contain more silt and clay throughout and less sand between depths of 10 and 40 inches than the Lihen soils. They are on the smoother parts of the landscape. Parshall, Tally, and Tansem Variant soils also contain less sand between depths of 10 and 40 inches. Parshall soils are in swales. Tally soils are in positions on the landscape similar to those of the Lihen soils. Tansem Variant and Wabek soils are on convex ridges. Wabek soils have gravelly sand within a depth of 14 inches.

Typical pedon of Lihen loamy fine sand, 6 to 20 percent slopes, 2,340 feet north and 2,140 feet east of the southwest corner of sec. 13, T. 127 N., R. 69 W.

A11—0 to 9 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak fine granular structure; loose; common very fine roots; neutral; gradual wavy boundary.

A12—9 to 15 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; loose; common very fine roots; neutral; clear wavy boundary.

AC—15 to 21 inches; grayish brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; single grain; loose; few very fine roots; neutral; clear wavy boundary.

C1—21 to 52 inches; pale brown (10YR 6/3) fine sand, dark brown (10YR 3/3) moist; single grain; loose; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—52 to 60 inches; pale brown (10YR 6/3) fine sand, dark brown (10YR 4/3) moist; single grain; loose; strong effervescence; mildly alkaline.

The depth to free carbonates is 10 inches or more. Reaction ranges from slightly acid to moderately alkaline throughout the profile. The control section is fine sand, loamy fine sand, or loamy sand. The content of sand and coarse sand is less than 50 percent. The mollic epipedon is 10 to 16 inches thick. Some pedons contain a small amount of fine gravel.

The A horizon has value of 4 or 5 (2 or 3 moist). It is loamy fine sand, fine sandy loam, or loamy sand and is 10 to 20 inches thick. The AC horizon has value of 4 to 6 (2 to 5 moist) and chroma of 2 to 4. The C horizon has value of 4 to 7 (3 to 5 moist) and chroma of 2 to 4. It is fine sand or loamy sand.

Marysland series

The Marysland series consists of poorly drained soils formed in loamy sediments in depressions and beach areas on glacial outwash plains. These soils are moderately deep over gravelly sand. Permeability is moderate in the loamy material and rapid in the underlying gravelly sand. Slopes are less than 2 percent.

Marysland soils are similar to Divide soils and commonly are near Bowdle, Divide, Lehr, and Regan soils. The well drained Bowdle and somewhat excessively drained Lehr soils are higher on the landscape than the Marysland soils. Divide soils are somewhat poorly drained. Regan soils do not have gravelly sand in the underlying material. They are slightly lower on the landscape than the Marysland soils.

Typical pedon of Marysland loam, 1,583 feet north and 381 feet east of the southwest corner of sec. 1, T. 126 N., R. 70 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable; many fine and very fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

A12—6 to 11 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak thick platy and weak medium subangular blocky structure; slightly hard, friable; common fine and very fine roots; strong effervescence; moderately alkaline; abrupt wavy boundary.

C1gca—11 to 19 inches; light gray (5Y 7/1) loam, gray (5Y 5/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2g—19 to 27 inches; gray (5Y 6/1) loam, dark gray (5Y 4/1) moist; common fine distinct yellowish brown (10YR 5/8) mottles; massive; soft, friable; few fine accumulations of carbonate; strong effervescence; moderately alkaline; clear wavy boundary.

IIC3—27 to 60 inches; multicolored gravelly sand; single grain; loose; slight effervescence; moderately alkaline.

The depth to gravelly sand ranges from 24 to 40 inches. The A horizon has value of 4 or 5 (2 or 3 moist). It is loam or clay loam and is 7 to 20 inches thick. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 1 or 2. It is loam, clay loam, or sandy clay loam. The IIC horizon is fine sand, sand, or gravelly sand.

Miranda series

The Miranda series consists of deep, moderately well drained and somewhat poorly drained soils formed in glacial till in microdepressions on uplands. Permeability is very slow. Slopes range from 0 to 5 percent.

Miranda soils commonly are near Cavour, Heil, Niobell, Noonan, and Williams soils. Cavour soils contain more clay in the subsoil than the Miranda soils. Also, they are slightly higher on the landscape. Heil soils are poorly drained. They are in depressions. Niobell and Noonan soils have visible salts below a depth of 16 inches. They are on slight rises. Also, Niobell soils do not have columnar structure in the B2t horizon. The well drained Williams soils are higher on the landscape than the Miranda soils. They do not have a natric horizon.

Typical pedon of Miranda loam, in an area of Niobell-Miranda loams, 0 to 3 percent slopes, 1,570 feet north and 163 feet east of the southwest corner of sec. 35, T. 125 N., R. 66 W.

A2—0 to 2 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; slightly hard, friable; neutral; abrupt smooth boundary.

B2t—2 to 9 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; strong medium columnar structure parting to moderate medium and fine blocky; very hard, firm, sticky and plastic; thin continuous gray (10YR 6/1) coatings on the tops of columns; mildly alkaline; clear wavy boundary.

B3cs—9 to 18 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium prismatic structure; hard, friable, sticky and plastic; few fine nests of gypsum; moderately alkaline; clear wavy boundary.

C1cacs—18 to 36 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; common fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; massive; hard, friable, sticky and plastic; common fine accumulations of carbonate; many fine nests and threads of gypsum; strong effervescence; strongly alkaline; gradual wavy boundary.

C2cs—36 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; many fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; massive; hard, friable, sticky and plastic; few fine accumulations of carbonate; many fine nests and threads of gypsum; strong effervescence; strongly alkaline.

The thickness of the solum ranges from 10 to 22 inches. The depth to free carbonates ranges from 8 to 25 inches. The depth to gypsum and salt accumulations ranges from 6 to 16 inches.

Some pedons have an A1 horizon, which is 1 to 3 inches thick. The A2 horizon has value of 5 to 7 (3 or 4 moist) and chroma of 1 or 2. It is loam or silt loam and is 2 to 5 inches thick. The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is clay loam or loam. The content of clay in this horizon averages as low as 25 percent in some pedons and as high as 35 percent in others. The C horizon has value of 5 to 8 (4 to 6 moist) and chroma of 2 to 4. It is clay loam or loam.

The Miranda soil occuring as part of the map units Cavour-Miranda loams, 1 to 5 percent slopes, and Miranda-Heil complex contains more clay in the B2t horizon than is definitive for the Miranda series. This difference, however, does not alter the use or behavior of the soil.

Mondamin series

The Mondamin series consists of deep, well drained and moderately well drained soils formed in clayey and silty glaciolacustrine sediments on uplands. Permeability is moderately slow or slow. Slopes range from 0 to 6 percent.

The Mondamin soils in this county have lower chroma in the A horizon and the upper part of the B horizon than is definitive for the Mondamin series. This difference, however, does not alter the use or behavior of the soils.

Mondamin soils are similar to Bearpaw soils and commonly are near Bryant, Grail, Grassna, and Williams soils. Bearpaw soils formed in loamy glacial till. Bryant

and Grassna soils contain less clay in the subsoil than the Mondamin soils. Grail soils have a mollic epipedon that is more than 16 inches thick. Williams soils contain less clay and more sand in the subsoil than the Mondamin soils. Bryant and Williams soils are in positions on the landscape similar to those of the Mondamin soils. Grassna and Grail soils are in swales.

Typical pedon of Mondamin silty clay loam, 3 to 6 percent slopes, 177 feet south and 36 feet west of the northeast corner of sec. 2, T. 126 N., R. 69 W.

Ap—0 to 5 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium and fine subangular blocky structure parting to moderate medium granular; hard, friable; neutral; abrupt smooth boundary.

B21t—5 to 9 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak coarse and medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; thin continuous shiny films on faces of peds; neutral; clear wavy boundary.

B22t—9 to 13 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; dark gray (10YR 4/1) tongues, very dark gray (10YR 3/1) moist; thin continuous shiny films on faces of peds; mildly alkaline; clear wavy boundary.

B3ca—13 to 35 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak coarse and medium prismatic structure parting to weak medium and coarse subangular blocky; very hard, firm, sticky and plastic; many medium accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C—35 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; many medium distinct gray (10YR 5/1) and common medium distinct light yellowish brown (10YR 6/4) mottles; hard, firm; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The depth to free carbonates ranges from 12 to 20 inches. The mollic epipedon ranges from 8 to 16 inches in thickness.

The A horizon has value of 4 or 5 (2 or 3 moist). It is silty clay loam or silt loam and is 4 to 8 inches thick. The B2t horizon has value of 4 or 5 (2 to 4 moist) and chroma of 1 to 3. It is silty clay loam or silty clay. The clay content in this horizon averages as low as 35 percent in some pedons and as high as 50 percent in others. Some pedons do not have a B3ca horizon. The C horizon has value of 6 or 7 (4 or 5 moist) and chroma of 2 to 4. It is silty clay loam or silt loam. It has lenses of very fine sand or fine sand in some pedons. Few to many mottles are below a depth of 30 inches.

Niobell series

The Niobell series consists of deep, moderately well drained soils formed in glacial till on uplands. Permeability is slow. Slopes range from 0 to 5 percent.

Niobell soils are similar to Cresbard soils and commonly are near Miranda, Noonan, Tonka, and Williams soils. Cresbard soils contain more clay in the subsoil than the Niobell soils. Miranda soils have visible salts within a depth of 16 inches. They are in small pits and depressions. Noonan soils have columnar structure in the B2t horizon. Their position on the landscape is similar to that of the Niobell soils. Tonka soils are poorly drained and are in the depressions. Williams soils do not have a natric horizon. They are on the higher parts of the landscape.

Typical pedon of Niobell loam, in an area of Niobell-Miranda loams, 0 to 3 percent slopes, 1,555 feet north and 142 feet east of the southwest corner of sec. 35, T. 125 N., R. 66 W.

A1—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear wavy boundary.

B&A—7 to 13 inches; dark grayish brown (10YR 4/2) loam (B), very dark brown (10YR 2/2) moist; grayish brown (10YR 5/2) silt coatings on faces of peds (A), dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to weak medium and thin platy and moderate medium and fine subangular blocky; hard, friable; common fine roots; slightly acid; gradual wavy boundary.

B21t—13 to 20 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to strong medium blocky; very hard, firm, sticky and plastic; common fine roots; common fine pores; tops and sides of prisms coated with patches of clean sand grains; shiny films on faces of peds; mildly alkaline; gradual wavy boundary.

B22t—20 to 26 inches; pale brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse and medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; mildly alkaline; clear wavy boundary.

B3ca—26 to 31 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine faint gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, firm, sticky and slightly plastic; common fine nests of gypsum; many fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1ca—31 to 39 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) and few

fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, firm, sticky and slightly plastic; many fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—39 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; many fine and medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, firm, sticky and slightly plastic; common fine accumulations of carbonate; moderately alkaline.

The thickness of the solum ranges from 15 to 36 inches. The depth to free carbonates ranges from 16 to 30 inches.

The A1 horizon has value of 4 or 5 (2 or 3 moist). It is loam or silt loam and is 5 to 10 inches thick. Some pedons have an A2 horizon. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. The clay content in this horizon averages as low as 27 percent in some pedons and as high as 35 percent in others. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam or clay loam.

Nishon series

The Nishon series consists of deep, poorly drained soils formed in local alluvium in depressions on uplands. Permeability is slow or very slow. Slopes are less than 1 percent.

Nishon soils are similar to Tonka soils and commonly are near Heil, Niobell, Tonka, and Williams soils. Heil and Niobell soils have a natric horizon. Tonka soils have a dark surface layer that is 8 or more inches thick. Williams soils are well drained. Heil and Tonka soils are in positions on the landscape similar to those of the Nishon soils. Niobell and Williams soils are in the slightly higher areas.

Typical pedon of Nishon silt loam, in an area of Nishon-Heil silt loams, 1,650 feet north and 359 feet east of the southwest corner of sec. 16, T. 128 N., R. 73 W.

A1—0 to 3 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak very thin platy structure; soft, very friable; common fine and very fine roots; slightly acid; abrupt smooth boundary.

A2—3 to 7 inches; gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; strong medium and thin platy structure; soft, very friable; common fine and very fine roots; slightly acid; abrupt wavy boundary.

B21t—7 to 12 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse columnar structure parting to strong medium subangular blocky; hard, firm, very sticky and very plastic; few fine roots; thin continuous gray (10YR 6/1) coatings on the tops of columns; neutral; abrupt wavy boundary.

B22t—12 to 19 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky and very plastic; few fine roots; mildly alkaline; clear wavy boundary.

B3—19 to 27 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine accumulations of carbonate; mildly alkaline; gradual wavy boundary.

C1—27 to 41 inches; dark gray (5Y 4/1) clay loam, very dark gray (5Y 3/1) moist; massive; hard, firm, sticky and plastic; common medium and fine accumulations of carbonate; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—41 to 60 inches; light gray (5Y 7/2) and dark gray (5Y 4/1) clay loam, olive gray (5Y 5/2) and very dark gray (5Y 3/1) moist; massive; very hard, firm, sticky and plastic; many large and medium accumulations of carbonate; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 45 inches. The A1 horizon has value of 5 or 6 (3 or 4 moist) and chroma of 1 or 2. It is silt loam or loam and is 1 to 4 inches thick. The A2 horizon has value of 5 or 6 (4 or 5 moist) and chroma of 1 or 2. It is silt loam or loam. The B2t horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 4 or 5 (3 or 4 moist) and chroma of 0 or 1. It is silty clay or clay. The clay content in this horizon averages as low as 40 percent in some pedons and as high as 60 percent in others. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1 to 3. It is silty clay, clay loam, or clay.

Noonan series

The Noonan series consists of deep, moderately well drained soils formed in glacial till on uplands. Permeability is slow. Slopes range from 1 to 5 percent.

Noonan soils are similar to Cavour, Letcher, and Noonan Variant soils and commonly are near Heil, Miranda, Niobell, and Williams soils. Cavour soils contain more clay in the subsoil than the Noonan soils. The poorly drained Heil soils are in depressions. Letcher soils contain less clay in the subsoil than the Noonan soils. Miranda soils have visible salts within a depth of 16 inches. They are in small pits and depressions. Niobell soils do not have columnar structure in the B2t horizon. They are in positions on the landscape similar to those of the Noonan soils. Noonan Variant soils have gravelly sand in the underlying material. The well drained Williams soils are on the higher parts of the landscape.

Typical pedon of Noonan loam, in an area of Niobell-Noonan loams, 1 to 5 percent slopes, 1,948 feet east

and 160 feet south of the northwest corner of sec. 14, T. 126 N., R. 66 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak very fine granular structure; soft, very friable; many fine roots; neutral; abrupt smooth boundary.

A2—6 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse and medium subangular blocky structure parting to weak thick platy; slightly hard, very friable; many fine roots; neutral; abrupt smooth boundary.

B21t—9 to 13 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; strong medium columnar structure parting to strong medium blocky; very hard, firm, sticky and plastic; common fine roots; thin continuous gray (10YR 6/1) coatings on the tops of columns; shiny films on faces of peds; mildly alkaline; clear wavy boundary.

B22t—13 to 19 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to strong medium and fine blocky; very hard, firm, sticky and plastic; few fine roots; common fine pores; patchy shiny films on faces of peds; mildly alkaline; clear wavy boundary.

B3cs—19 to 28 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; very hard, friable, sticky and plastic; many fine nests and threads of gypsum; few fine nests and threads of salt crystals; slight effervescence; moderately alkaline; clear wavy boundary.

C1cs—28 to 41 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; massive; hard, friable, sticky and slightly plastic; common fine nests of gypsum; few fine nests of salt crystals; few medium concretions of iron oxide; common fine accumulations of carbonate; slight effervescence; moderately alkaline; gradual wavy boundary.

C2—41 to 50 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; few medium concretions of iron and manganese oxide; common fine accumulations of carbonate; slight effervescence; moderately alkaline; gradual wavy boundary.

C3ca—50 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; many medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; massive; hard, friable, slightly sticky and plastic; few medium concretions of iron and manganese oxide; common fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 14 to 32 inches. The depth to free carbonates ranges from 15 to 35 inches.

The Ap or A1 horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is loam or silt loam and is 5 to 10 inches thick. The A2 horizon has value of 5 to 7 (3 to 5 moist) and chroma of 1 or 2. It is loam, silt loam, or fine sandy loam and is 1 to 4 inches thick. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. In some pedons it has visible salt crystals in the lower part. It ranges from neutral to moderately alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam or clay loam and is moderately alkaline or strongly alkaline.

Noonan Variant

The Noonan Variant consists of moderately well drained soils on terraces. These soils are moderately deep over sandy and loamy alluvium and gravelly sand. They formed in glacial outwash. Permeability is slow in the solum and rapid in the underlying material. Slopes range from 0 to 2 percent.

Noonan Variant soils are similar to Noonan soils and commonly are near Harriet, Letcher, Niobell, Noonan, and Ranslo soils. Harriet and Ranslo soils contain more clay in the subsoil than the Noonan Variant soils. They are on flood plains. Letcher soils contain less clay in the subsoil than the Noonan Variant soils. Niobell and Noonan soils do not have sandy loam, loamy fine sand, or shaly gravelly sand in the underlying material. Letcher, Niobell, and Noonan soils are in positions on the landscape similar to those of the Noonan Variant soils.

Typical pedon of Noonan Variant loam, 0 to 2 percent slopes, 760 feet south and 63 feet east of the northwest corner of sec. 4, T. 126 N., R. 66 W.

A11—0 to 4 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, very friable; many fine roots; slightly acid; clear smooth boundary.

A12—4 to 9 inches; dark grayish brown (10YR 4/2) loam, black (10YR 2/1) moist; weak medium prismatic structure parting to moderate coarse and medium subangular blocky; slightly hard, friable; many fine roots; medium acid; clear wavy boundary.

A2—9 to 12 inches; light brownish gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; many fine roots; neutral; abrupt wavy boundary.

B21t—12 to 17 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong coarse columnar structure; very hard, firm, sticky and plastic; thin continuous gray (10YR 6/1) coatings on the tops of columns; common fine roots; dark grayish brown (10YR 4/2 moist) coatings on faces of peds; neutral; clear wavy boundary.

B22t—17 to 22 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; strong coarse prismatic structure parting to weak coarse subangular blocky; very hard, firm, sticky and plastic; few medium roots; neutral; clear wavy boundary.

B3sa—22 to 26 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, friable; few medium roots; common fine threads of salt; moderately alkaline; clear wavy boundary.

IIC1sa—26 to 36 inches; light brownish gray (2.5Y 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; few medium threads of salt; mildly alkaline; clear wavy boundary.

IIC2ca—36 to 41 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; few fine accumulations of carbonate; strong effervescence; moderately alkaline; clear wavy boundary.

IIC3—41 to 60 inches; multicolored gravelly sand; loose; 20 to 30 percent shale fragments; thin coatings of lime on the underside of the pebbles; strong effervescence; moderately alkaline.

The thickness of the solum, or the depth to the contrasting underlying material, ranges from 20 to 40 inches. Reaction ranges from medium acid to neutral in the A horizon and from neutral to moderately alkaline in the B and C horizons.

The A1 horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is 5 to 10 inches thick. The A2 horizon has hue of 10YR or 2.5Y, value of 5 to 7 (3 or 4 moist), and chroma of 1 or 2. It is loam or fine sandy loam. The B2t horizon has hue of 10YR or 2.5Y, value of 3 to 6 (2 to 4 moist), and chroma of 1 to 3. The clay content in this horizon averages as low as 27 percent in some pedons and as high as 35 percent in others. The IIC horizon is stratified loamy sand, loamy fine sand, or sandy loam in the upper part and multicolored gravelly sand in the lower part. The content of shale fragments is 15 to 40 percent in the lower part.

Parnell series

The Parnell series consists of deep, very poorly drained soils formed in clayey alluvium in depressions on uplands. Permeability is slow. Slopes are 0 to 1 percent.

Parnell soils commonly are near Bowbells, Vallers, Vida, and Williams soils. The moderately well drained and well drained Bowbells soils are in swales. Vallers soils have a calcic horizon. They are in drainageways and shallow depressions. The well drained Vida and Williams soils are on uplands.

Typical pedon of Parnell silty clay loam, 2,510 feet east and 150 feet north of the southwest corner of sec. 30, T. 125 N., R. 69 W.

A1—0 to 7 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium and fine subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and plastic; many fine roots; slightly acid; clear smooth boundary.

B21t—7 to 13 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; many fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to moderate fine blocky; very hard, firm, sticky and plastic; common fine roots; neutral; gradual smooth boundary.

B22tg—13 to 26 inches; gray (10YR 5/1) silty clay, very dark gray (5Y 3/1) moist; weak medium blocky structure parting to moderate fine blocky; very hard, firm, sticky and plastic; neutral; gradual smooth boundary.

B23tg—26 to 45 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; weak medium blocky structure parting to moderate fine blocky; very hard, firm, sticky and plastic; neutral; gradual smooth boundary.

Cg—45 to 60 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; massive; very hard, firm, sticky and plastic; neutral.

The thickness of the solum ranges from 35 to 50 inches. In some pedons 4 inches of organic mulch is at the surface.

The A1 horizon is silty clay loam, silty clay, or silt loam. It ranges from slightly acid to mildly alkaline and is 6 to 18 inches thick. The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 to 4 moist, and chroma of 1 or 2. It is silty clay loam, silty clay, clay loam, or clay. The content of clay in this horizon averages as low as 35 percent in some pedons and as high as 50 percent in others. Reaction ranges from slightly acid to mildly alkaline. Some pedons have a B3 horizon. The C horizon has hue of 2.5Y or 5Y, value of 3 to 6 moist, and chroma of 1 or 2. It ranges from neutral to moderately alkaline.

Parshall series

The Parshall series consists of deep, well drained soils formed in alluvial outwash material on uplands. Permeability is moderately rapid. Slopes range from 0 to 3 percent.

The Parshall soils in this county have lower chroma in the solum than is definitive for the Parshall series. This difference, however, does not alter the use or behavior of the soils.

Parshall soils commonly are near Letcher, Lihen, and Tally soils. Letcher soils have a natric horizon. They are on the lower parts of the landscape. Lihen and Tally soils have a mollic epipedon that is less than 16 inches thick. They are on the higher parts of the landscape.

Typical pedon of Parshall fine sandy loam, in an area of Lihen-Parshall fine sandy loams, 0 to 6 percent

slopes, 1,900 feet west and 1,524 feet north of the southeast corner of sec. 12, T. 128 N., R. 70 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak coarse and medium subangular blocky structure; soft, very friable; common very fine roots; neutral; abrupt smooth boundary.

B2—8 to 19 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable; few very fine roots; neutral; clear wavy boundary.

C1—19 to 33 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse and medium subangular blocky structure; soft, very friable; neutral; clear wavy boundary.

C2—33 to 60 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; soft, very friable; neutral.

The thickness of the solum ranges from 18 to 45 inches. The mollic epipedon ranges from 18 to more than 40 inches in thickness.

The A horizon has value of 4 or 5 (2 or 3 moist). It is loam, fine sandy loam, or sandy loam and is 8 to 20 inches thick. The B2 horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (3 to 5 moist), and chroma of 2 or 3. It is fine sandy loam, sandy loam, loamy fine sand, or loamy sand.

Ranslo series

The Ranslo series consists of deep, somewhat poorly drained soils formed in alluvium on flood plains. Permeability is slow. Slopes range from 0 to 2 percent.

Ranslo soils commonly are near Bowbells, Harriet, Miranda, Niobell, and Noonan soils. The moderately well drained and well drained Bowbells soils are in swales on uplands. They do not have a natric horizon. The poorly drained Harriet soils are in small pits and depressions on the flood plains. Miranda, Niobell, and Noonan soils contain more sand throughout and less clay in the subsoil than the Ranslo soils. They are on glacial till uplands.

Typical pedon of Ranslo loam, in an area of Ranslo-Harriet loams, 2,290 feet north and 1,080 feet east of the southwest corner of sec. 10, T. 125 N., R. 67 W.

A11—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium and fine subangular blocky structure parting to weak medium and fine granular; soft, very friable; many fine and very fine roots; slightly acid; clear smooth boundary.

A12—6 to 10 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak coarse and medium subangular blocky structure; soft, very friable; common fine and very fine roots; slightly acid; clear smooth boundary.

A2—10 to 15 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium and fine subangular blocky structure; slightly hard, friable; common fine and very fine roots; neutral; abrupt smooth boundary.

B21t—15 to 23 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium columnar structure parting to moderate medium blocky; very hard, firm, sticky and plastic; gray (10YR 5/1) coatings on the tops of columns; neutral; clear wavy boundary.

B22t—23 to 28 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, firm, sticky and plastic; moderately alkaline; clear wavy boundary.

B3ca—28 to 33 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct dark yellowish brown (10YR 4/6) mottles; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm, sticky and plastic; few fine accumulations of salt crystals; common medium and fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1ca—33 to 43 inches; light gray (2.5Y 7/2) clay loam, light brownish gray (2.5Y 6/2) moist; few fine distinct dark yellowish brown (10YR 4/6) mottles; massive; hard, firm, sticky and plastic; few fine accumulations of salt crystals; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—43 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; common medium and fine distinct dark yellowish brown (10YR 4/6) mottles; massive; very hard, firm, sticky and plastic; few fine accumulations of salt crystals; common fine accumulations of carbonate; strong effervescence; strongly alkaline.

The thickness of the solum ranges from 23 to 36 inches. The mollic epipedon is 10 to 35 inches thick.

The A1 horizon has value of 4 or 5 (2 or 3 moist). It is loam or silt loam and is 5 to 10 inches thick. Some pedons do not have an A2 horizon. The B2t horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 or 3 moist). It is clay loam, silty clay loam, or silty clay. Some pedons do not have a B3 horizon. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is dominantly clay loam, silty clay loam, silty clay, or clay. In some pedons, however, it has coarser textured strata below a depth of 40 inches. It is moderately alkaline or strongly alkaline.

Regan series

The Regan series consists of deep, very poorly drained and poorly drained soils formed in alluvium in channels on outwash plains and flood plains. Permeability is moderate or moderately slow. Slopes are less than 1 percent.

Regan soils commonly are near Bearden, Divide, Harriet, Marysland, and Vallers soils. The somewhat poorly drained Bearden and Divide soils are slightly higher on the landscape than the Regan soils. Harriet soils have a natric horizon. They are in positions on the landscape similar to those of the Regan soils. Marysland soils are 20 to 40 inches deep over gravelly sand. They are slightly higher on the landscape than the Regan soils. Vallers soils contain more sand throughout and less silt between depths of 10 and 40 inches than the Regan soils. They are on the uplands.

Typical pedon of Regan silt loam, wet, 160 feet west and 462 feet south of the northeast corner of sec. 34, T. 127 N., R. 71 W.

A1—0 to 5 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; moderate medium and fine granular structure; soft, friable; slight effervescence; moderately alkaline; clear smooth boundary.

ACca—5 to 15 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak coarse and medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; strong effervescence; moderately alkaline; clear wavy boundary.

C1gca—15 to 28 inches; gray (5Y 6/1) silt loam, gray (5Y 5/1) moist; moderate fine granular structure; hard, friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2gca—28 to 55 inches; light gray (5Y 7/1) silt loam, gray (5Y 6/1) moist; weak fine subangular blocky structure; hard, friable; violent effervescence; strongly alkaline; clear smooth boundary.

IIC3g—55 to 60 inches; gray (5Y 6/1) clay loam, gray (5Y 5/1) moist; common medium and fine distinct dark yellowish brown (10YR 4/6) mottles; massive; extremely hard, firm, sticky and plastic; many medium accumulations of carbonate; many coarse accumulations of manganese oxide; moderately alkaline.

The content of clay in the control section averages as low as 28 percent in some pedons and as high as 35 percent in others. Reaction ranges from mildly alkaline to strongly alkaline throughout the profile. The calcium carbonate equivalent ranges from 16 to 55 percent within a depth of 15 inches. The mollic epipedon ranges from 7 to 16 inches in thickness.

The A1 horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is silt loam, silty clay loam, or clay loam and is 5 to 12 inches thick. Some pedons do not have an AC horizon. The Cca horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7 (3 to 6 moist), and chroma of 1 or 2. The IIC horizon commonly is clay loam or sandy clay loam, but in some pedons it is stratified with sandy loam, loam, or silty clay loam. Some pedons have sand and gravel at a depth of 40 to 60 inches.

Rentill series

The Rentill series consists of deep, well drained soils formed in loamy sediments over clayey glaciolacustrine sediments and loamy glacial till. These soils are on lake plains. They are moderately or moderately rapidly permeable in the upper part and slowly permeable in the lower part. Slopes range from 0 to 2 percent.

The Rentill soils in this county are shallower to carbonates than is definitive for the Rentill series. Also, they do not have a gravelly layer in the underlying material and have clayey lacustrine sediments over the glacial till. These differences, however, do not alter the use or behavior of the soils.

Rentill soils commonly are near Arnegard, Bearden, Exline, and Harmony soils. Arnegard soils contain less sand in the upper part than the Rentill soils. They are in similar positions on the landscape. The somewhat poorly drained Bearden soils are slightly lower on the landscape than the Rentill soils. Exline soils have a natric horizon. They are in small pits and depressions. Harmony soils contain more clay in the upper part than the Rentill soils. Also, they are slightly lower on the landscape.

Typical pedon of Rentill loam, 948 feet north and 81 feet west of the southeast corner of sec. 1, T. 128 N., R. 67 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; many very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—7 to 12 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium and fine subangular blocky structure parting to weak medium granular; hard, friable; many very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1ca—12 to 23 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; soft, very friable; many very fine roots; gray (10YR 6/1) tongues, dark gray (10YR 4/1) moist; strong effervescence; mildly alkaline; gradual wavy boundary.

C2ca—23 to 31 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable; many very fine roots; gray

(10YR 6/1) tongues, dark gray (10YR 4/1) moist; few fine accumulations of carbonate; strong effervescence; mildly alkaline; abrupt smooth boundary.

IIC3—31 to 50 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; moderate fine and very fine blocky structure; hard, firm, sticky and plastic; few very fine roots; many medium and fine accumulations of carbonate; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC4—50 to 55 inches; dark gray (5Y 4/1) clay loam, black (5Y 2/1) moist; massive; slightly hard, firm, sticky and plastic; few very fine roots; few fine nests of gypsum; common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear smooth boundary.

IIC5—55 to 60 inches; gray (5Y 5/1) clay loam, very dark gray (5Y 3/1) moist; massive; slightly hard, firm, sticky and plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline.

The depth to free carbonates ranges from 0 to 12 inches. The mollic epipedon ranges from 8 to 16 inches in thickness. The depth to clayey lacustrine deposits or glacial till is 27 to 38 inches.

The A horizon has value of 3 or 4 (2 or 3 moist). It is loam or fine sandy loam and is 6 to 15 inches thick. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is sandy loam, fine sandy loam, or loamy fine sand. It is mildly alkaline or moderately alkaline. The IIC horizon has hue of 2.5Y or 5Y. It is silty clay loam, silty clay, or clay loam.

Roseglen series

The Roseglen series consists of deep, moderately well drained soils formed in loamy, silty, and gravelly glaciolacustrine sediments in swales on uplands. Permeability is moderate. Slopes range from 0 to 3 percent.

The Roseglen soils in this county have lower chroma in the A horizon than is definitive for the Roseglen series. This difference, however, does not alter the use or behavior of the soils.

Roseglen soils are similar to Arnegard soils and commonly are near Bryant, Lehr, Tansem, Tansem Variant, and Williams soils. Arnegard soils are well drained. Bryant, Lehr, Tansem, Tansem Variant, and Williams soils have a mollic epipedon that is less than 16 inches thick. They are higher on the landscape than the Roseglen soils. Bryant soils contain more silt throughout and less sand between depths of 10 and 40 inches than the Roseglen soils. Lehr soils are less than 20 inches deep over gravelly sand. Tansem Variant soils do not have a B horizon. Williams soils have an argillic horizon.

Typical pedon of Roseglen loam, in an area of Tansem-Roseglen loams, 2 to 6 percent slopes, 75 feet south and 2,586 feet east of the northwest corner of sec. 6, T. 128 N., R. 69 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; many fine and very fine roots; neutral; abrupt smooth boundary.

A12—6 to 9 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; many fine and very fine roots; neutral; clear wavy boundary.

B2—9 to 23 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; common fine and very fine roots; neutral; clear wavy boundary.

B3ca—23 to 33 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; few very fine roots; few medium accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C1ca—33 to 40 inches; white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable; few very fine roots; few fine accumulations of carbonate; strong effervescence; mildly alkaline; abrupt smooth boundary.

C2—40 to 45 inches; light yellowish brown (2.5Y 6/4) gravelly sand, olive brown (2.5Y 4/4) moist; single grain; loose; strong effervescence; neutral; abrupt smooth boundary.

C3—45 to 60 inches; light gray (2.5Y 7/2) stratified sandy loam to clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 38 inches. The depth to free carbonates ranges from 18 to 30 inches. The mollic epipedon ranges from 16 to 40 inches in thickness.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is loam or silt loam and is 6 to 12 inches thick. The B2 horizon has value of 3 to 5 and chroma of 2 or 3. Some pedons do not have a B3ca horizon. The Cca horizon has value of 6 to 8 (4 to 6 moist) and chroma of 2 to 4. It has few to many, fine to large accumulations of carbonate. The lower part of the C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. The upper part of the C horizon is stratified or laminated loam, silt loam, or fine sandy loam. Below a depth of 40 inches, the texture ranges from gravelly sand to clay loam.

Stirum series

The Stirum series consists of deep, poorly drained soils formed in loamy and sandy alluvium in upland depressions. Permeability is slow. Slopes are less than 1 percent.

The Stirum soils in this county are more acid throughout, are finer textured below a depth of 40 inches, and are wetter than is definitive for the Stirum series. These differences, however, do not alter the use or behavior of the soils.

Stirum soils commonly are near Letcher, Niobell, Noonan, Parshall, and Tally soils. Letcher soils are moderately well drained. Niobell and Noonan soils contain more clay in the subsoil than the Stirum soils. Parshall and Tally soils do not have a natric horizon. Letcher, Niobell, Noonan, and Tally soils are higher on the landscape than the Stirum soils. Parshall soils are in swales.

Typical pedon of Stirum loam, 1,300 feet south and 700 feet east of the northwest corner of sec. 26, T. 125 N., R. 66 W.

O1—1 inch to 0; partly decomposed matted grass and roots.

A1—0 to 6 inches; gray (10YR 5/1) loam, black (10YR 2/1) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine granular structure; slightly hard, friable; strongly acid; abrupt smooth boundary.

A2—6 to 8 inches; gray (10YR 6/1) fine sandy loam, very dark gray (10YR 3/1) moist; many medium and fine distinct gray (10YR 5/1) and dark yellowish brown (10YR 4/4) mottles; weak medium and thin platy structure; slightly hard, friable; strongly acid; abrupt smooth boundary.

B21t—8 to 14 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; many medium and fine distinct gray (10YR 5/1) and dark yellowish brown (10YR 4/6) and common fine distinct yellowish brown (10YR 5/6) mottles; strong coarse and medium columnar structure parting to strong medium blocky; hard, friable; gray (10YR 6/1) coatings on the top of columns and on faces of peds; medium acid; clear wavy boundary.

B22t—14 to 19 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) and few fine distinct gray (10YR 5/1) mottles; moderate coarse and medium prismatic structure parting to moderate coarse subangular blocky; hard, friable; neutral; clear wavy boundary.

C1—19 to 24 inches; light brownish gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; few medium and fine distinct dark brown (7.5YR 4/4) and many medium and fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; neutral; clear wavy boundary.

C2—24 to 41 inches; light gray (2.5Y 7/2) loamy sand, light brownish gray (2.5Y 6/2) moist; common fine distinct yellowish brown (l0YR 5/6) mottles; massive; slightly hard, friable; dark brown (7.5YR 4/4) iron stains and black (N 2/0) manganese stains; slight effervescence; mildly alkaline; clear wavy boundary.

IIC3—41 to 60 inches; light gray (5Y 7/1) clay loam, gray (5Y 5/1) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; very hard, firm, sticky and plastic; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 15 to 30 inches. The depth to free carbonates ranges from 20 to 40 inches. Reaction ranges from strongly acid in the upper horizons to strongly alkaline in the lower horizons.

The A1 horizon has value of 4 or 5 (2 or 3 moist). It is loam, fine sandy loam, or sandy loam. The A2 horizon has value of 6 or 7 (3 to 5 moist) and chroma of 1 or 2. It is fine sandy loam, sandy loam, loamy fine sand, or loamy sand. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 1 or 2. It is sandy clay loam or sandy loam. The C horizon is loamy sand or fine sand. Some pedons do not have a IIC horizon.

Straw series

The Straw series consists of deep, moderately well drained soils formed in alluvium on flood plains. Permeability is moderate. Slopes are less than 2 percent.

The Straw soils in this county are more stratified and have a thinner surface layer than is definitive for the Straw series. Also, they are not so well drained. These differences, however, do not alter the use or behavior of the soils.

Straw soils commonly are near Lehr, Vida, Wabek, Williams, and Zahl soils. Lehr and Wabek soils have gravelly sand within a depth of 20 inches. They are on terraces. The well drained Vida, Williams, and Zahl soils are on uplands.

Typical pedon of Straw loam, channeled, 400 feet east and 375 feet north of the southwest corner of sec. 14, T. 128 N., R. 67 W.

A11—0 to 5 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak very fine granular structure; slightly hard, very friable; slight effervescence; mildly alkaline; clear wavy boundary.

A12—5 to 15 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak very fine granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C1—15 to 22 inches; grayish brown (10YR 5/2) stratified loam, fine sandy loam, and silt loam, dark gray (10YR 4/1) and dark grayish brown (10YR 4/2)

moist; common fine distinct yellowish brown (10YR 5/4) mottles; massive; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIAb—22 to 33 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

IIC3—33 to 40 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable; strong effervescence; mildly alkaline; clear wavy boundary.

IIC4—40 to 60 inches; grayish brown (2.5Y 5/2) stratified loam and loamy sand, very dark grayish brown (2.5Y 3/2) moist; massive; hard, very friable; strong effervescence; mildly alkaline.

The A horizon has value of 3 to 5 (2 or 3 moist). It is loam or silt loam. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR or 2.5Y. It is stratified loam, silt loam, fine sandy loam, sandy loam, loamy sand, or gravelly sand. It is mildly alkaline or moderately alkaline.

Tally series

The Tally series consists of deep, well drained soils formed in loamy and sandy glacial outwash on uplands. Permeability is moderately rapid. Slopes range from 0 to 6 percent.

Tally soils commonly are near Brantford, Bryant, Letcher, Parshall, and Williams soils. Brantford soils have gravelly sand at a depth of 10 to 20 inches. They are lower on the landscape than the Tally soils. Bryant soils contain more silt throughout and less sand between depths of 10 and 40 inches than the Tally soils. They are on the uplands. Letcher soils have a natric horizon. They are in low areas. Parshall soils have a mollic epipedon that is more than 16 inches thick. They are in swales. Williams soils contain more clay in the subsoil than the Tally soils. They are on uplands.

Typical pedon of Tally fine sandy loam, 2 to 6 percent slopes, 816 feet east and 114 feet south of the northwest corner of sec. 13, T. 126 N., R. 66 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine roots; neutral; clear smooth boundary.

B21—8 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; common very fine roots; common very fine and fine pores; neutral; clear smooth boundary.

B22—11 to 17 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable; common very fine roots; common very fine and fine pores; neutral; clear smooth boundary.

B3—17 to 28 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; neutral; clear smooth boundary.

C1ca—28 to 34 inches; light brownish gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; single grain; loose, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C2ca—34 to 54 inches; light brownish gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grain; loose, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C3—54 to 60 inches; light brownish gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grain; loose, very friable; strong effervescence; mildly alkaline.

The mollic epipedon ranges from 10 to 15 inches in thickness. The depth to free carbonates ranges from 15 to 30 inches. The clay content in the control section averages as low as 8 percent in some pedons and as high as 18 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist). It is fine sandy loam or sandy loam and is 7 to 10 inches thick. The B2 horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is fine sandy loam or sandy loam. Some pedons do not have a B3 horizon. The C horizon is dominantly loamy fine sand, fine sandy loam, loamy sand, or fine sand, but clay loam glacial till is at a depth of 40 to 60 inches in some pedons.

Tansem series

The Tansem series consists of deep, well drained soils formed in loamy and silty glaciolacustrine sediments on uplands. Permeability is moderate. Slopes range from 2 to 6 percent.

Tansem soils commonly are near Bryant, Lehr, Roseglen, Tansem Variant, and Williams soils. Bryant, Lehr, and Williams soils are in positions on the landscape similar to those of the Tansem soils. Bryant soils contain more silt throughout and less sand between depths of 10 and 40 inches than the Tansem soils. Lehr soils have gravelly sand within a depth of 20 inches. Williams soils have an argillic horizon. Roseglen soils have a mollic epipedon that is more than 16 inches thick. They are in swales. Tansem Variant soils do not have a B horizon. They are higher on the landscape than the Tansem soils.

Typical pedon of Tansem loam, in an area of Tansem-Roseglen loams, 2 to 6 percent slopes, 195 feet south and 2,560 feet east of the northwest corner of sec. 6, T. 128 N., R. 69 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

B2—7 to 15 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

C1ca—15 to 29 inches; white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable; few medium accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—29 to 38 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; common fine distinct gray (10YR 6/1) mottles; massive; slightly hard, friable; strong effervescence; mildly alkaline; clear wavy boundary.

C3—38 to 54 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; common fine distinct gray (10YR 6/1) mottles; massive; slightly hard, friable; strong effervescence; mildly alkaline; clear wavy boundary.

IIC4—54 to 60 inches; light brownish gray (2.5Y 6/2) clay loam stratified with thin layers of very fine sand, grayish brown (2.5Y 5/2) moist; common fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/8) and few fine distinct yellowish red (5YR 5/8) mottles; massive; slightly hard, firm; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 14 to 20 inches. The mollic epipedon ranges from 7 to 16 inches in thickness.

The A horizon has value of 4 or 5 (2 or 3 moist). It is loam or silt loam and is 5 to 10 inches thick. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. Some pedons have a B3ca horizon. The Cca horizon has value of 6 to 8 (4 to 6 moist) and chroma of 2 to 4. The carbonates are disseminated or occur as accumulations. The lower part of the C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. In some pedons it is stratified loam, silt, silt loam, or fine sandy loam. Some pedons are finer textured or have strata of gravelly sand below a depth of 40 inches.

Tansem Variant

The Tansem Variant consists of deep, well drained soils formed in stratified sediments on glacial lake plains in the uplands. Permeability is moderate. Slopes range from 9 to 15 percent.

Tansem Variant soils are similar to Zahl soils and commonly are near Bryant, Lihen, Roseglen, Tansem, and Wabek soils. Bryant soils contain more silt throughout and less sand between depths of 10 and 40 inches than the Tansem Variant soils. They are lower on the landscape than the Tansem Variant soils. Lihen soils contain more sand in the solum than the Tansem Variant soils. They are in similar positions on the landscape. Roseglen soils have a mollic epipedon that is more than 16 inches thick. They are in swales. Tansem soils have a prominent subsoil. They are lower on the landscape than the Tansem Variant soils. Wabek soils have gravelly sand within a depth of 14 inches. Zahl soils formed in glacial till and are not stratified.

Typical pedon of Tansem Variant loam, 9 to 15 percent slopes, 1,190 feet north and 400 feet east of the southwest corner of sec. 33, T. 126 N., R. 70 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, friable; slight effervescence; neutral; abrupt smooth boundary.

C1ca—7 to 13 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable; common fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C2ca—13 to 24 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, friable; common fine accumulations of carbonate; strong effervescence; mildly alkaline; abrupt irregular boundary.

C3—24 to 33 inches; light brownish gray (2.5Y 6/2) very fine sandy loam stratified with thin lenses of silt loam and fine sand, grayish brown (2.5Y 5/2) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, friable; few fine accumulations of carbonate; strong effervescence; mildly alkaline; abrupt irregular boundary.

C4—33 to 60 inches; light gray (5Y 7/2) stratified fine sand and silty clay loam, olive gray (5Y 5/2) moist; common medium and fine distinct dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, friable; few fine accumulations of carbonate; strong effervescence; mildly alkaline.

The upper 3 to 5 inches is leached of carbonates in some pedons. Reaction is neutral or mildly alkaline in the A horizon and mildly alkaline or moderately alkaline in the C horizon.

The A horizon has value of 4 or 5 (2 or 3 moist). It is loam or fine sandy loam and is 4 to 8 inches thick. Some pedons have an AC horizon. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is stratified fine sand to silty clay loam.

Temvik series

The Temvik series consists of deep, well drained soils formed in a silty mantle over loamy glacial till on

uplands. Permeability is moderate in the subsoil and moderately slow in the underlying material. Slopes range from 3 to 6 percent.

Temvik soils are similar to Bryant soils and commonly are near Bearpaw, Grassna, and Williams soils. Bearpaw and Williams soils are in positions on the landscape similar to those of the Temvik soils. Bearpaw soils contain more clay in the subsoil than the Temvik soils, and Williams soils contain more sand throughout and less silt in the subsoil. Bryant soils do not have clay loam glacial till within a depth of 40 inches. Grassna soils have a mollic epipedon that is more than 16 inches thick. They are in swales.

Typical pedon of Temvik silt loam, in an area of Temvik-Grassna-Bearpaw complex, 1 to 6 percent slopes, 1,464 feet east and 342 feet south of the northwest corner of sec. 18, T. 128 N., R. 72 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, friable; neutral; abrupt smooth boundary.

B2—8 to 22 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

B3—22 to 27 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

IIC1—27 to 31 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable; common fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC2ca—31 to 47 inches; light gray (2.5Y 7/2) clay loam, light brownish gray (2.5Y 6/2) moist; massive; hard, firm, sticky and plastic; many fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

IIC3—47 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine distinct strong brown (7.5YR 5/8) mottles; massive; hard, firm, sticky and plastic; few fine accumulations of carbonate; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 30 inches. The depth to loamy glacial till ranges from 20 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist). It is silt loam or loam that is 5 to 10 inches thick. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. The IIC horizon has hue of 2.5Y or 5Y, value 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Tonka series

The Tonka series consists of deep, poorly drained soils formed in local alluvium in depressions on uplands. Permeability is slow. Slopes are 0 to 1 percent.

Tonka soils are similar to Nishon soils and commonly are near Bowbells, Niobell, Nishon, and Williams soils. The moderately well drained and well drained Bowbells soils are in swales. Niobell soils have a natric horizon. They are slightly higher on the landscape than the Tonka soils. Nishon soils do not have a mollic epipedon. The well drained Williams soils are on the higher parts of the landscape.

Typical pedon of Tonka silt loam, in an area of Tonka-Nishon silt loams, 1,780 feet east and 75 feet south of the northwest corner of sec. 29, T. 125 N., R. 67 W.

A1—0 to 8 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure in the upper part and weak thin platy and fine granular in the lower part; soft, friable; few medium and fine roots; slightly acid; abrupt wavy boundary.

A2—8 to 12 inches; light gray (10YR 7/1) loam, dark grayish brown (10YR 4/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and thin platy structure; slightly hard, friable; few fine and very fine roots; medium acid; abrupt wavy boundary.

B21t—12 to 22 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong coarse prismatic structure parting to moderate fine blocky; very hard, firm, sticky and plastic; few fine and very fine roots; bleached sand grains on tops of prisms and along vertical faces of peds; medium acid; gradual wavy boundary.

B22t—22 to 34 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse prismatic structure parting to moderate medium and fine blocky; very hard, firm, sticky and plastic; few fine and very fine roots; slightly acid; clear wavy boundary.

B3ca—34 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium and fine blocky; hard, firm, sticky and plastic; few fine and very fine roots; common fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

IICgca—42 to 60 inches; light gray (5Y 7/2) clay loam, olive gray (5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium and fine blocky structure; hard, firm, sticky and plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 28 to 60 inches or more.

The A horizon has hue of 10YR or is neutral in hue. The A1 horizon has value of 3 or 4 (2 or 3 moist) and chroma of 0 or 1. It is silt loam, loam, or silty clay loam and ranges from 8 to 15 inches in thickness. The A2 horizon has value of 5 to 7 (3 to 5 moist) and chroma of 0 to 2. It has few or common, faint or distinct mottles. It is loam, silt loam, or silty clay loam. It is 4 to 16 inches thick, and it interfingers into the B2t horizon in some pedons. Some pedons have an A&B horizon. The B2t horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 to 4 moist, and chroma of 1 or 2. It is silty clay, clay loam, clay, or silty clay loam. Some pedons do not have a B3 horizon.

Vallers series

The Vallers series consists of deep, poorly drained soils formed in calcareous glacial till in shallow depressions and drainageways. Permeability is moderately slow. Slopes range from 0 to 2 percent.

Vallers soils commonly are near Bowbells, Hamerly, Parnell, Regan, and Williams soils. The well drained and moderately well drained Bowbells soils are in swales. Hamerly soils do not have mottles within a depth of 20 inches. They are slightly higher on the landscape than the Vallers soils. The very poorly drained Parnell soils are in depressions. Regan soils contain more silt throughout and less sand between depths of 10 and 40 inches than the Vallers soils. They are in positions on the landscape similar to those of the Vallers soils. The well drained Williams soils are on uplands.

Typical pedon of Vallers silty clay loam, 222 feet north and 1,012 feet east of the southwest corner of sec. 19, T. 125 N., R. 72 W.

A1—0 to 7 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and plastic; strong effervescence; moderately alkaline; clear smooth boundary.

ACca—7 to 13 inches; gray (10YR 5/1 and 6/1) silty clay loam, black (10YR 2/1) and dark gray (10YR 4/1) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; violent effervescence; mildly alkaline; gradual smooth boundary.

C1gca—13 to 36 inches; gray (5Y 6/1) clay loam, dark gray (5Y 4/1) moist; few fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, sticky and plastic; violent effervescence; moderately alkaline; gradual smooth boundary.

C2gca—36 to 41 inches; light gray (5Y 7/1) clay loam, gray (5Y 5/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C3g—41 to 60 inches; light gray (5Y 7/1) clay loam, olive gray (5Y 5/2) moist; common fine and medium distinct yellowish brown (10YR 5/8) mottles; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The mollic epipedon ranges from 7 to 22 inches in thickness. The calcium carbonate equivalent ranges from 20 to 35 percent within a depth of 16 inches.

The A horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 (2 or 3 moist) and chroma of 0 or 1. It is clay loam, silty clay loam, or loam and is 6 to 18 inches thick. It is mildly alkaline or moderately alkaline. Some pedons do not have an ACca horizon. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7, and chroma of 1 to 3.

Vida series

The Vida series consists of deep, well drained soils formed in glacial till on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 3 to 25 percent.

Vida soils are similar to Williams soils and commonly are near Bowbells, Williams, Zahill, and Zahl soils. Bowbells soils have a mollic epipedon that is more than 16 inches thick. They are in swales. Williams soils do not have carbonates within a depth of 10 inches. Zahill and Zahl soils are on the higher parts of the landscape. Zahill soils do not have a mollic epipedon, and Zahl soils do not have an argillic horizon.

Typical pedon of Vida loam (fig. 11), in an area of Vida-Williams-Bowbells loams, 2 to 15 percent slopes, 320 feet east and 175 feet north of the southwest corner of sec. 27, T. 125 N., R. 69 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak and moderate medium and fine granular structure; hard, friable; many fine roots; neutral; clear wavy boundary.

B2t—4 to 9 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse and medium prismatic structure parting to moderate medium subangular blocky; hard, friable; many fine roots; thin patchy shiny films on faces of peds; mildly alkaline; clear wavy boundary.

B3ca—9 to 21 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; few very dark grayish brown (10YR 3/2) coatings on faces of peds; common fine roots; common medium and fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C1ca—21 to 29 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; massive; hard, firm, slightly sticky and plastic;

common fine distinct dark brown (7.5YR 4/4) iron stains; common fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Figure 11.—Profile of Vida loam. Calcium carbonate is at a depth of about 9 inches. Depth is marked in feet.

C2—29 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; massive; hard, firm, sticky and plastic; common fine distinct dark brown (7.5YR 4/4) iron stains; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 8 to 24 inches. Free carbonates are within a depth of 10 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 2 or 3. It is clay loam, loam, or extremely stony loam and is 2 to 7 inches thick. The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 (4 to 6 moist), and chroma of 1 to 4. It is loam or clay loam. The mottles and stains in this horizon are inherited from the parent material.

Wabek series

The Wabek series consists of excessively drained soils on terraces and outwash plains. These soils are very shallow or shallow over gravelly sand. They formed in glacial outwash. Permeability is very rapid. Slopes range from 2 to 20 percent.

Wabek soils commonly are near Bowdle, Lehr, and Tally soils. Bowdle soils are 20 to 40 inches deep over gravelly material. They are lower on the landscape than the Wabek soils. Lehr and Tally soils are in positions on the landscape similar to those of the Wabek soils. Lehr soils are 14 to 20 inches deep over gravelly sand. In Tally soils the content of gravel is, by volume, less than 35 percent between depths of 10 and 40 inches.

Typical pedon of Wabek gravelly loam, 6 to 20 percent slopes (fig. 12), 924 feet west and 160 feet north of the southeast corner of sec. 8, T. 126 N., R. 69 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; neutral; gradual smooth boundary.

IIC1—6 to 9 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; single grain; loose; slight effervescence; neutral; gradual smooth boundary.

IIC2ca—9 to 60 inches; multicolored gravelly sand; single grain; loose; violent effervescence; mildly alkaline.

The depth to gravelly sand ranges from 7 to 14 inches. The depth to free carbonates generally ranges from 4 to 9 inches, but some pedons do not have free carbonates.

The A horizon has value of 4 or 5 (2 or 3 moist). It typically is gravelly loam but is loam, sandy loam, loamy sand, or gravelly loamy sand in some pedons. It ranges from 5 to 11 inches in thickness.

Figure 12.—Profile of Wabek gravelly loam, 6 to 20 percent slopes. Gravelly sand is at a depth of about 9 inches. Depth is marked in feet.

Williams series

The Williams series consists of deep, well drained soils formed in glacial till on uplands. Permeability is moderate in the subsoil and moderately slow in the underlying material. Slopes range from 0 to 15 percent.

Williams soils are similar to Greenway and Vida soils and commonly are near Bowbells, Niobell, Tonka, Vida, and Zahl soils. Bowbells soils have a mollic epipedon that is more than 16 inches thick. They are in swales. The underlying material in Greenway soils is more dense and more compact than that in the Williams soils. Niobell soils have a natric horizon. They are on the less sloping parts of the landscape. Tonka soils are poorly drained and are in depressions. Vida soils have free carbonates within a depth of 10 inches. Zahl soils do not have an argillic horizon. Vida and Zahl soils are on the steeper parts of the landscape above the Williams soils.

Typical pedon of Williams loam, in an area of Williams-Bowbells-Tonka complex, 0 to 3 percent slopes, 2,500 feet west and 236 feet south of the northeast corner of sec. 33, T. 125 N., R. 68 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; neutral; clear wavy boundary.

B21t—6 to 12 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) crushing to dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; many fine roots; thin patchy shiny films on faces of peds; neutral; clear wavy boundary.

B22t—12 to 17 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; common fine roots; thin patchy shiny films on faces of peds; neutral; clear wavy boundary.

B3ca—17 to 25 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; few fine roots; thin patchy shiny films on faces of peds; common fine and few medium accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C1ca—25 to 42 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) and few fine distinct gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; massive; hard, friable, sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; many fine

distinct yellowish brown (10YR 5/6) and few fine distinct gray (10YR 6/1) and strong brown (7.5YR 5/6) mottles; massive; hard, firm, slightly sticky and plastic; few fine accumulations of carbonate; few fine distinct concretions of manganese oxide; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 10 to 30 inches. The A horizon is loam, silt loam, or clay loam and is 4 to 9 inches thick. It has value of 4 or 5 (2 or 3 moist). In some areas that support native grass, the upper 1 to 3 inches has chroma of 1. The B horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is loam or clay loam. The clay content in this horizon averages as low as 24 percent in some pedons and as high as 35 percent in others. The C horizon has hue of 2.5Y or 5Y, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4. It is loam or clay loam. The mottles in this horizon are inherited from the parent material.

Zahill series

The Zahill series consists of deep, well drained soils formed in glacial till on ridges in the uplands. Permeability is moderately slow. Slopes range from 15 to 25 percent.

Zahill soils are similar to Zahl soils and commonly are near Bowbells, Vida, Williams, and Zahl soils. Bowbells soils have a mollic epipedon that is more than 16 inches thick. They are in swales and on toe slopes. Vida and Williams soils have an argillic horizon. Vida soils are on the upper side slopes, and Williams soils are on the middle side slopes. The surface layer of Zahl soils is thicker than that of the Zahill soils.

Typical pedon of Zahill loam, in an area of Vida-Zahill loams, 15 to 25 percent slopes, 2,308 feet east and 48 feet south of the northwest corner of sec. 18, T. 126 N., R. 69 W.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; mildly alkaline; clear wavy boundary.

C1ca—3 to 10 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; many medium and fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C2ca—10 to 27 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse and medium subangular blocky structure; slightly hard, friable; common medium and fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C3—27 to 40 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline; gradual wavy boundary.

C4—40 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable; strong effervescence; moderately alkaline.

Free carbonates are at the surface in some pedons. The A horizon has value of 4 or 5. It is loam or clay loam and is 2 to 4 inches thick. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3.

Zahl series

The Zahl series consists of deep, well drained soils formed in glacial till on uplands. Permeability is moderate in the upper horizons and moderately slow in the underlying material. Slopes range from 6 to 15 percent.

Zahl soils are similar to Tansem Variant and Zahill soils and commonly are near Bowbells, Vida, Williams, and Zahill soils. Bowbells, Vida, and Williams soils have an argillic horizon. Bowbells soils have a mollic epipedon that is more than 16 inches thick. They are in swales and on toe slopes. Vida soils are on the upper side slopes, and Williams soils are on the middle side slopes. Tansem Variant soils formed in stratified sediments. The surface layer of Zahill soils is thin.

Typical pedon of Zahl loam, in an area of Vida-Zahl loams, 6 to 15 percent slopes, 2,360 feet south and 310 feet east of the northwest corner of sec. 23, T. 127 N., R. 68 W.

A11—0 to 2 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure parting to weak very fine granular; slightly hard, friable; many roots; neutral; clear smooth boundary.

A12—2 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; common roots; strong effervescence; mildly alkaline; clear smooth boundary.

C1—6 to 26 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium and fine subangular blocky structure; soft, very friable; common roots; common fine accumulations of carbonate; violent effervescence; mildly alkaline; clear smooth boundary.

C2—26 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The content of clay in the control section averages as low as 20 percent in some pedons and as high as 30 percent in others. Free carbonates are within a depth of 10 inches.

The A horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 or 3 moist). It is loam or clay loam and ranges from 4 to 8 inches in thickness. Some pedons have an AC horizon. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

formation of the soils

Soil forms when chemical and physical processes act on geologically deposited or accumulated material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil having genetically related horizons. Usually, a long time is required for development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. The following paragraphs relate the factors of soil formation to the soils in McPherson County.

climate

Climate directly influences the rate of chemical and physical weathering. McPherson County has a continental climate marked by cold winters and hot summers. This climate favors the growth of grasses and the resulting accumulation of organic matter in the upper part of the soil. The precipitation is sufficient to leach carbonates in most soils to an average depth of about 16 inches. The climate is generally uniform throughout the county and thus as a separate factor does not differentiate the soils within the county. Additional climatic data are given under the heading "General nature of the county."

plant and animal life

Plants, animals, insects, earthworms, bacteria, and fungi have an important effect on soil formation. They cause gains in organic matter, gains or losses in plant nutrients, and changes in soil structure and porosity. In McPherson County the tall and mid prairie grasses have had more influence than other living organisms on soil formation. As a result of these grasses, the surface layer of many soils has a moderate or high content of organic matter. Bowbells soils are an example.

Earthworms, insects, and burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose plant residue, thus releasing nutrients that plants use as food.

parent material

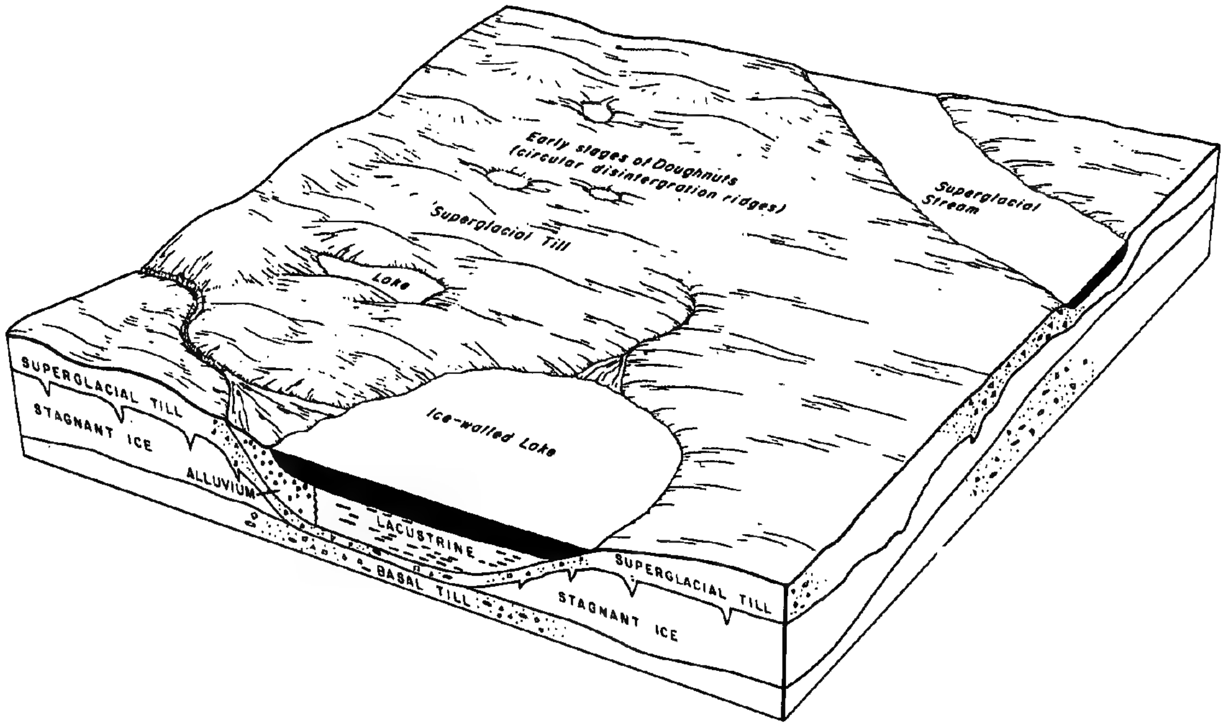
Most of the soils in McPherson County formed in glacial material derived from preglacial formations of gneiss, granite, limestone, sandstone, siltstone, and shale. The glacier ground up and mixed this material. The resultant mass is an aggregate of sand, silt, and clay and some rock fragments.

The county is in two physiographic regions. The eastern third is on the James River Lowland, and the western two-thirds is on the Missouri Coteau. The boundary between these two regions is marked by the Missouri Escarpment.

The Missouri Coteau is rolling to hilly and has a poorly defined drainage pattern and many potholes and sloughs. In places as much as 250 feet of glacial till overlies the shale bedrock. During glaciation the glacial ice in this region had a thick overburden of "superglacial till" (fig. 13, top). The resulting landforms are characteristic of glacial stagnation (*6*). Examples are dead-ice moraines; formerly ice-walled lake plains; circular disintegration ridges, which have the appearance of doughnuts on aerial photos; and gravelly ridges of collapsed stream alluvium (fig. 13, bottom) (*5*). A rolling to hilly dead-ice moraine formed when the glacial ice beneath the superglacial till melted. Vida, Zahill, and Williams soils are typical of the soils that formed on this landscape. Many depressional soils, such as Tonka and Parnell, also formed on this landscape.

As the ice melted, streams formed on the superglacial till and along the margin of the glacier. These streams deposited coarse material along the channels. Bowdle, Lehr, and Wabek soils formed in this gravelly superglacial stream alluvium. Perennial lakes are also in these areas. They commonly are saline.

Ice-walled lake plains formed where a superglacial stream terminated in a lake. The finer textured material settled in the lake, and after a time the sediments became very thick. As the glacial ice melted, a formation resembling a mesa remained. The formerly ice-walled



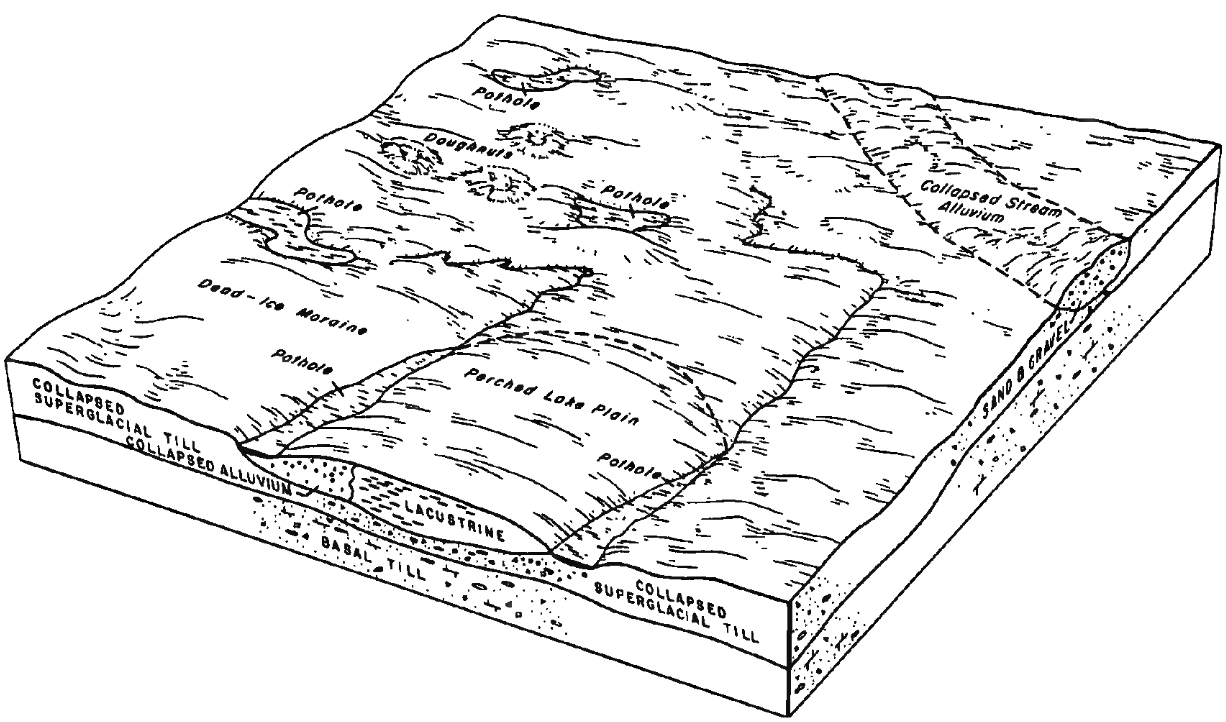


Figure 13.—Top: Missouri Coteau during the glacial period.
Bottom: Present-day Missouri Coteau.

lake plain is higher than the surrounding landscape. Mondamin and Bryant soils formed in these sediments.

Niobell and Noonan soils formed in glacial till having a high content of salts. Bowbells and Williams soils, however, have not been affected by saline ground water.

Bowbells, Grail, Parnell, and Tonka are examples of soils formed partly or entirely in local alluvium washed in from adjacent sloping uplands. Harriet, Ranslo, and Straw soils formed in alluvium deposited by streams.

relief

Relief affects drainage, runoff, erosion, plant cover, and soil temperature. Zahill soils, for example, lose much rainfall because of excessive runoff. As a result of the excessive runoff, a limited amount of moisture penetrates the surface and much soil is lost through erosion. These soils are calcareous at or near the surface. The layers in which organic matter accumulates are thin.

The runoff rate is slower on the Bryant and Williams soils than on the Zahill soils. As a result, more moisture penetrates the surface and the layers in which organic matter accumulates are thicker. Also, calcium carbonate is leached to a depth of more than 10 inches.

Bowbells and Grassna soils are in swales that receive extra moisture in the form of runoff from adjacent soils. The layers in which organic matter accumulates are thicker than those in the Bryant and Williams soils. Also, calcium carbonate is leached to a greater depth. The seasonal high water table in areas where drainage is impeded favors the concentration of salts in Harriet and other soils.

time

The length of time that the climate, plant and animal life, and relief have affected the parent material helps to determine the kind of soil that forms. All of the soils in McPherson County are young. The youngest are those on active flood plains, such as Straw soils.

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glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compact layers to depths below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour farming. Growing crops in rows or strips that follow the contour.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: Natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the

properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and mangement. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data were recorded in the period 1959-77 at Leola, South Dakota]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	19.2	-1.7	8.8	48	-30	0	.41	.13	.64	2	4.9
February---	27.2	5.6	16.4	53	-24	0	.53	.18	.80	2	7.8
March------	39.0	16.7	27.9	72	-17	80	1.01	.20	1.65	2	5.0
April------	55.7	30.5	43.1	87	8	159	2.38	1.00	3.49	5	4.6
May--------	69.3	41.9	55.6	92	21	484	3.15	1.61	4.40	7	.0
June-------	79.3	52.6	66.0	98	38	780	3.49	1.44	5.15	6	.0
July-------	86.0	57.1	71.6	103	43	980	2.73	1.15	3.99	5	.0
August-----	85.2	55.0	70.1	103	40	933	1.97	.75	2.95	4	.0
September--	72.6	43.8	58.2	97	23	546	1.71	.37	2.76	4	.1
October----	61.0	33.6	47.3	87	13	256	1.02	.39	1.52	2	.6
November---	40.3	18.6	29.5	70	-9	11	.55	.10	.88	2	5.5
December---	25.2	5.4	15.3	56	-26	0	.51	.18	.77	2	6.2
Yearly:											
Average--	55.0	30.1	42.5	---	---	---	---	---	---	---	---
Extreme--	---	---	---	106	-30	---	---	---	---	---	---
Total----	---	---	---	---	---	4,229	19.46	15.81	22.93	43	34.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data were recorded in the period 1959-77 at Leola, South Dakota]

Probability	Temperature: 24° F or lower	Temperature: 28° F or lower	Temperature: 32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	June 6	June 14	June 29
2 years in 10 later than--	May 21	May 28	June 11
5 years in 10 later than--	April 19	April 26	May 7
First freezing temperature in fall:			
1 year in 10 earlier than--	September 28	September 17	September 9
2 years in 10 earlier than--	October 4	September 23	September 15
5 years in 10 earlier than--	October 15	October 4	September 24

TABLE 3.--GROWING SEASON

[Data were recorded in the period 1959-77 at Leola, South Dakota]

Probability	Daily minimum temperature: Higher than 24° F	Daily minimum temperature: Higher than 28° F	Daily minimum temperature: Higher than 32° F
	Days	Days	Days
9 years in 10	129	110	90
8 years in 10	146	128	107
5 years in 10	178	161	140
2 years in 10	210	194	173
1 year in 10	227	212	190

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
3A	Bowdle loam, 0 to 3 percent slopes	8,850	1.2
3B	Bowdle loam, 3 to 6 percent slopes	880	0.1
5A	Bowbells loam, 0 to 2 percent slopes	3,790	0.5
5B	Bowbells loam, 2 to 6 percent slopes	2,800	0.4
6	Arnegard loam	2,090	0.3
7	Bearden silt loam	1,610	0.2
8	Rentill loam	1,440	0.2
9A	Bearpaw loam, 0 to 3 percent slopes	490	0.1
9B	Bearpaw loam, 3 to 6 percent slopes	3,480	0.5
9C	Bearpaw loam, 6 to 9 percent slopes	2,560	0.3
10	Brantford loam	3,090	0.4
11A	Bearpaw-Greenway loams, 0 to 3 percent slopes	6,630	0.9
11B	Bearpaw-Greenway loams, 3 to 6 percent slopes	6,740	0.9
13E	Zahl-Kloten loams, 9 to 35 percent slopes	580	0.1
14D	Vida extremely stony loam, 3 to 15 percent slopes	14,300	1.9
15A	Williams-Bowbells loams, 0 to 3 percent slopes	29,170	4.0
15B	Williams-Bowbells loams, 1 to 6 percent slopes	99,470	13.7
15C	Williams-Bowbells loams, 2 to 9 percent slopes	7,520	1.0
16A	Williams-Bowbells-Tonka complex, 0 to 3 percent slopes	11,240	1.5
16B	Williams-Bowbells-Tonka complex, 1 to 6 percent slopes	29,610	4.0
16C	Williams-Bowbells-Parnell complex, 1 to 9 percent slopes	10,460	1.4
17B	Vida-Williams loams, 3 to 6 percent slopes	42,970	5.9
17C	Vida-Williams-Bowbells loams, 2 to 15 percent slopes	97,750	13.4
17D	Vida-Zahl loams, 6 to 15 percent slopes	17,390	2.4
17E	Vida-Zahill loams, 15 to 25 percent slopes	11,390	1.6
18A	Williams-Niobell loams, 0 to 3 percent slopes	15,940	2.2
20A	Lehr loam, 0 to 3 percent slopes	7,990	1.1
20B	Lehr loam, 3 to 6 percent slopes	5,020	0.7
21A	Cavour-Miranda loams, 1 to 5 percent slopes	2,270	0.3
22A	Niobell-Miranda loams, 0 to 3 percent slopes	24,450	3.3
23A	Noonan Variant loam, 0 to 2 percent slopes	1,350	0.2
24A	Niobell-Noonan loams, 1 to 5 percent slopes	46,550	6.3
25	Miranda-Heil complex	6,030	0.8
26	Cresbard-Cavour loams	1,970	0.3
27B	Lehr-Bowdle loams, 0 to 6 percent slopes	25,990	3.5
29	Exline-Harmony complex	560	0.1
30	Letcher-Parshall loams, 0 to 4 percent slopes	4,430	0.6
31	Harmony silty clay loam	1,360	0.2
32	Harmony-Exline complex	1,390	0.2
37	Straw loam, channeled	1,910	0.3
38	Regan silt loam	1,750	0.2
40A	Mondamin silty clay loam, 0 to 3 percent slopes	570	0.1
40B	Mondamin silty clay loam, 3 to 6 percent slopes	340	*
43C	Wabek-Bowdle complex, 3 to 15 percent slopes	17,690	2.4
44D	Wabek gravelly loam, 6 to 20 percent slopes	9,020	1.2
45B	Wabek-Lehr complex, 2 to 9 percent slopes	15,480	2.1
52B	Lihen-Parshall fine sandy loams, 0 to 6 percent slopes	2,320	0.3
52D	Lihen loamy fine sand, 6 to 20 percent slopes	1,360	0.2
54B	Tansem-Roseglen loams, 2 to 6 percent slopes	2,150	0.3
55A	Parshall-Tally fine sandy loams, 0 to 3 percent slopes	970	0.1
55B	Tally fine sandy loam, 2 to 6 percent slopes	4,610	0.6
56D	Tansem Variant loam, 9 to 15 percent slopes	1,500	0.2
57A	Bryant-Grassna silt loams, 0 to 3 percent slopes	4,300	0.6
57B	Bryant-Grassna silt loams, 1 to 6 percent slopes	8,490	1.2
57C	Bryant silt loam, 6 to 9 percent slopes	600	0.1
58B	Temvik-Grassna-Bearpaw complex, 1 to 6 percent slopes	2,930	0.4
62	Hamerly loam	2,560	0.3
64	Grassna silt loam	1,810	0.2
65	Grail silty clay loam	1,150	0.2
72	Ranslo-Harriet loams	14,240	1.9
75	Tonka-Nishon silt loams	8,180	1.1
76	Parnell silty clay loam	15,490	2.1
77	Nishon-Heil silt loams	3,950	0.5
80	Heil silt loam	4,690	0.6
82	Stirum loam	540	0.1
85	Ranslo loam	5,090	0.7
86	Harriet loam	6,030	0.8
87	Marysland loam	2,400	0.3
88	Divide loam	2,820	0.4
97	Regan silt loam, wet	3,600	0.5

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
98	Vallers silty clay loam	3,170	0.4
99	Pits, gravel	400	0.1
100	Parnell silty clay loam, ponded	15,360	2.1
	Water (less than 40 acres in size)	4,946	0.7
	Total land area	734,016	100.0
	Water (more than 40 acres in size)	2,624	
	Total area	736,640	

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Only arable soils are listed. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Spring wheat	Oats	Flax	Alfalfa hay	Cool season grasses
	Bu	Bu	Bu	Ton	AUM*
3A Bowdle	21	44	15	1.2	2.0
3B Bowdle	19	41	13	1.1	1.8
5A Bowbells	31	67	19	3.1	5.2
5B Bowbells	30	60	18	2.7	4.5
6 Arnegard	31	62	20	2.9	4.8
7 Bearden	30	65	17	2.5	4.2
8 Rentill	29	50	15	2.0	3.3
9A Bearpaw	27	56	17	2.2	3.7
9B Bearpaw	26	54	15	2.0	3.3
9C Bearpaw	17	40	12	1.5	2.5
10 Brantford	18	40	10	1.1	1.8
11A Bearpaw-Greenway	28	57	17	2.1	3.5
11B Bearpaw-Greenway	26	54	15	2.0	3.3
15A Williams-Bowbells	29	60	18	2.3	3.8
15B Williams-Bowbells	27	57	16	2.1	3.5
15C Williams-Bowbells	21	48	12	1.8	3.0
16A Williams-Bowbells-Tonka	26	55	14	2.1	3.5
16B Williams-Bowbells-Tonka	23	51	13	2.0	3.3
16C Williams-Bowbells-Parnell	17	42	---	1.7	2.8

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Flax	Alfalfa hay	Cool season grasses
	Bu	Bu	Bu	Ton	AUM*
17B: Vida-Williams	22	46	14	1.8	3.0
17C: Vida-Williams-Bowbells	17	42	---	1.6	2.7
17D: Vida-Zahl	---	---	---	1.0	1.7
18A: Williams-Niobell	28	57	16	2.2	3.7
20A: Lehr	17	36	10	1.1	1.8
20B: Lehr	14	33	7	1.0	1.7
21A: Cavour-Miranda	10	19	---	0.7	1.2
22A: Niobell-Miranda	14	29	7	1.1	1.8
23A: Noonan Variant	15	29	7	1.2	2.0
24A: Niobell-Noonan	17	39	9	1.3	2.2
26: Cresbard-Cavour	20	41	10	1.4	2.3
27B: Lehr-Bowdle	18	40	10	1.2	2.0
29: Exline-Harmony	18	29	9	1.6	2.7
30: Letcher-Parshall	18	39	7	1.6	2.7
31: Harmony	30	60	17	2.6	4.3
32: Harmony-Exline	25	48	14	2.0	3.3
40A: Mondamin	25	57	17	2.0	3.3
40B: Mondamin	23	54	16	1.9	3.2
43C: Wabek-Bowdle	14	29	7	1.3	2.2
45B: Wabek-Lehr	9	22	---	0.5	1.0
52B: Lihen-Parshall	19	40	10	1.3	2.2
54B: Tansem-Roseglen	27	56	16	2.3	3.8

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Flax	Alfalfa hay	Cool season grasses
	Bu	Bu	Bu	Ton	AUM*
55A------------------------ Parshall-Tally	22	46	15	1.8	3.0
55B------------------------ Tally	19	40	14	1.6	2.7
56D------------------------ Tansem Variant	10	24	---	0.7	1.2
57A------------------------ Bryant-Grassna	30	60	18	2.3	3.8
57B------------------------ Bryant-Grassna	27	57	16	2.1	3.5
57C------------------------ Bryant	20	45	---	1.6	2.7
58B------------------------ Temvik-Grassna-Bearpaw	26	55	16	2.1	3.5
62------------------------- Hamerly	21	56	13	2.1	3.5
64------------------------- Grassna	31	68	20	3.1	5.2
65------------------------- Grail	30	63	18	2.8	4.7
72------------------------- Ranslo-Harriet	12	29	7	1.4	2.3
82------------------------- Stirum	---	---	---	1.5	2.5
85------------------------- Ranslo	19	44	12	2.2	3.7
88------------------------- Divide	21	45	13	1.8	3.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
3A, 3B-------------Bowdle	Silty	Favorable	2,900	Green needlegrass	30
		Normal	2,400	Western wheatgrass	25
		Unfavorable	1,700	Needleandthread	25
				Blue grama	10
5A-----------------Bowbells	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
5B-----------------Bowbells	Silty	Favorable	3,600	Western wheatgrass	25
		Normal	3,000	Needleandthread	20
		Unfavorable	2,100	Green needlegrass	20
				Blue grama	5
6------------------Arnegard	Silty	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,000	Green needlegrass	15
				Needleandthread	5
7------------------Bearden	Limy Subirrigated	Favorable	4,300	Little bluestem	30
		Normal	3,600	Needlegrass	15
		Unfavorable	2,800	Big bluestem	10
				Western wheatgrass	10
				Sedge	5
				Sideoats grama	5
				Blue grama	5
8------------------Rentill	Silty	Favorable	3,400	Needlegrass	30
		Normal	2,800	Western wheatgrass	30
		Unfavorable	2,000	Little bluestem	10
				Big bluestem	10
				Sideoats grama	5
				Sedge	5
				Blue grama	5
9A, 9B, 9C---------Bearpaw	Clayey	Favorable	3,100	Western wheatgrass	25
		Normal	2,600	Needlegrass	25
		Unfavorable	1,800	Little bluestem	10
				Prairie junegrass	5
				Blue grama	5
10-----------------Brantford	Shallow to Gravel	Favorable	2,400	Needleandthread	25
		Normal	2,000	Western wheatgrass	10
		Unfavorable	1,200	Green needlegrass	10
				Blue grama	10
				Plains muhly	5
11A*, 11B*:					
Bearpaw	Clayey	Favorable	3,100	Western wheatgrass	25
		Normal	2,600	Needlegrass	25
		Unfavorable	1,800	Little bluestem	10
				Prairie junegrass	5
				Blue grama	5
Greenway	Silty	Favorable	3,100	Green needlegrass	25
		Normal	2,600	Western wheatgrass	25
		Unfavorable	1,800	Little bluestem	15
				Needleandthread	15
				Blue grama	5
				Sideoats grama	5
				Sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
13E*:					
Zahl	Thin Upland	Favorable	2,600	Little bluestem	30
		Normal	2,200	Needleandthread	15
		Unfavorable	1,500	Western wheatgrass	10
				Green needlegrass	5
				Sideoats grama	5
				Porcupinegrass	5
Kloten	Shallow	Favorable	2,500	Little bluestem	25
		Normal	2,100	Western wheatgrass	15
		Unfavorable	1,500	Needleandthread	10
				Green needlegrass	10
				Blue grama	10
				Plains muhly	5
				Sideoats grama	5
				Sedge	5
14D Vida	Silty	Favorable	3,000	Needlegrass	35
		Normal	2,500	Western wheatgrass	25
		Unfavorable	1,750	Little bluestem	10
				Blue grama	10
				Sideoats grama	10
				Sedge	5
15A*, 15B*, 15C*:					
Williams	Silty	Favorable	3,100	Western wheatgrass	30
		Normal	2,600	Needleandthread	20
		Unfavorable	1,800	Green needlegrass	20
				Blue grama	10
				Little bluestem	10
Bowbells	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
16A*, 16B*:					
Williams	Silty	Favorable	3,100	Western wheatgrass	30
		Normal	2,600	Needleandthread	20
		Unfavorable	1,800	Green needlegrass	20
				Blue grama	10
				Little bluestem	10
Bowbells	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
Tonka	Wet Meadow	Favorable	4,700	Slim sedge	20
		Normal	4,300	Wooly sedge	20
		Unfavorable	3,000	Prairie cordgrasss	20
				Western wheatgrass	10
				Northern reedgrass	10
16C*:					
Williams	Silty	Favorable	3,100	Western wheatgrass	30
		Normal	2,600	Needleandthread	20
		Unfavorable	1,800	Green needlegrass	20
				Blue grama	10
				Little bluestem	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
16C*:					
Bowbells	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
Parnell	Shallow Marsh	Favorable	6,600	Slough sedge	35
		Normal	6,000	Rivergrass	30
		Unfavorable	4,800	Prairie cordgrass	15
				American mannagrass	10
				Reedgrass	5
17B*:					
Vida	Silty	Favorable	3,000	Western wheatgrass	25
		Normal	2,500	Needleandthread	20
		Unfavorable	1,750	Green needlegrass	15
				Little bluestem	10
				Sideoats grama	10
				Sedge	5
Williams	Silty	Favorable	3,100	Western wheatgrass	30
		Normal	2,600	Needleandthread	20
		Unfavorable	1,800	Green needlegrass	20
				Blue grama	10
				Little bluestem	10
17C*:					
Vida	Silty	Favorable	3,000	Western wheatgrass	25
		Normal	2,500	Needleandthread	20
		Unfavorable	1,750	Green needlegrass	15
				Little bluestem	10
				Sideoats grama	10
				Sedge	5
Williams	Silty	Favorable	3,100	Western wheatgrass	30
		Normal	2,600	Needleandthread	20
		Unfavorable	1,800	Green needlegrass	20
				Blue grama	10
				Little bluestem	10
Bowbells	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
17D*:					
Vida	Silty	Favorable	3,000	Western wheatgrass	25
		Normal	2,500	Needleandthread	20
		Unfavorable	1,750	Green needlegrass	15
				Little bluestem	10
				Sideoats grama	10
				Sedge	5
Zahl	Thin Upland	Favorable	2,600	Little bluestem	30
		Normal	2,200	Needleandthread	15
		Unfavorable	1,500	Western wheatgrass	10
				Green needlegrass	5
				Sideoats grama	5
				Porcupinegrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
17E*:					
Vida	Silty	Favorable	3,000	Western wheatgrass	25
		Normal	2,500	Needleandthread	20
		Unfavorable	1,750	Green needlegrass	15
				Little bluestem	10
				Sideoats grama	10
				Sedge	5
Zahill	Thin Upland	Favorable	2,500	Little bluestem	30
		Normal	2,100	Needlegrass	15
		Unfavorable	1,500	Sideoats grama	10
				Western wheatgrass	10
				Prairie sandreed	5
				Sedge	5
18A*:					
Williams	Silty	Favorable	3,100	Western wheatgrass	30
		Normal	2,600	Needleandthread	20
		Unfavorable	1,800	Green needlegrass	20
				Blue grama	10
				Little bluestem	10
Niobell	Clayey	Favorable	2,900	Western wheatgrass	40
		Normal	2,400	Green needlegrass	25
		Unfavorable	1,700	Blue grama	10
				Sideoats grama	5
				Sedge	5
20A, 20B Lehr	Shallow to Gravel	Favorable	2,200	Needleandthread	35
		Normal	1,800	Western wheatgrass	10
		Unfavorable	1,100	Blue grama	10
				Plains muhly	5
				Green needlegrass	5
21A*:					
Cavour	Claypan	Favorable	2,400	Western wheatgrass	45
		Normal	2,000	Green needlegrass	20
		Unfavorable	1,400	Blue grama	15
				Sedge	10
				Buffalograss	5
Miranda	Thin Claypan	Favorable	1,600	Blue grama	30
		Normal	1,300	Western wheatgrass	15
		Unfavorable	800	Buffalograss	10
				Sedge	10
				Needleandthread	5
				Inland saltgrass	5
				Grizzlybear pricklypear	5
22A*:					
Niobell	Clayey	Favorable	2,900	Western wheatgrass	40
		Normal	2,400	Green needlegrass	25
		Unfavorable	1,700	Blue grama	10
				Sideoats grama	5
				Sedge	5
Miranda	Thin Claypan	Favorable	1,600	Blue grama	30
		Normal	1,300	Western wheatgrass	15
		Unfavorable	800	Buffalograss	10
				Sedge	10
				Needleandthread	5
				Inland saltgrass	5
				Grizzlybear pricklypear	5
23A Noonan Variant	Claypan	Favorable	2,200	Western wheatgrass	45
		Normal	1,800	Blue grama	20
		Unfavorable	1,300	Green needlegrass	15
				Sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
24A*:					
Niobell	Clayey	Favorable	2,900	Western wheatgrass	40
		Normal	2,400	Green needlegrass	25
		Unfavorable	1,700	Blue grama	10
				Sideoats grama	5
				Sedge	5
Noonan	Claypan	Favorable	2,200	Western wheatgrass	45
		Normal	1,800	Blue grama	20
		Unfavorable	1,300	Green needlegrass	15
				Sedge	5
25*:					
Miranda	Thin Claypan	Favorable	1,600	Blue grama	30
		Normal	1,300	Western wheatgrass	15
		Unfavorable	800	Buffalograss	10
				Sedge	10
				Needleandthread	5
				Inland saltgrass	5
				Grizzlybear pricklypear	5
Heil	Closed Depression	Favorable	3,400	Western wheatgrass	75
		Normal	3,100	Sedge	10
		Unfavorable	2,200		
26*:					
Cresbard	Clayey	Favorable	3,100	Green needlegrass	35
		Normal	2,500	Western wheatgrass	30
		Unfavorable	1,800	Sideoats grama	10
				Blue grama	10
				Little bluestem	5
				Sedge	5
Cavour	Claypan	Favorable	2,400	Western wheatgrass	45
		Normal	2,000	Green needlegrass	20
		Unfavorable	1,400	Blue grama	15
				Sedge	10
				Buffalograss	5
27B*:					
Lehr	Shallow to Gravel	Favorable	2,200	Needleandthread	35
		Normal	1,800	Western wheatgrass	10
		Unfavorable	1,100	Blue grama	10
				Plains muhly	5
				Green needlegrass	5
Bowdle	Silty	Favorable	2,900	Green needlegrass	30
		Normal	2,400	Western wheatgrass	25
		Unfavorable	1,700	Needleandthread	25
				Blue grama	10
29*:					
Exline	Thin Claypan	Favorable	1,800	Blue grama	30
		Normal	1,500	Western wheatgrass	20
		Unfavorable	900	Buffalograss	10
				Sedge	10
				Needleandthread	5
				Inland saltgrass	5
				Pricklypear	5
Harmony	Clayey	Favorable	3,100	Western wheatgrass	35
		Normal	2,600	Green needlegrass	30
		Unfavorable	1,800	Sideoats grama	10
				Little bluestem	5
				Big bluestem	5
				Blue grama	5
				Sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
30*:					
Letcher	Sandy	Favorable	3,000	Little bluestem	25
		Normal	2,500	Needleandthread	20
		Unfavorable	1,800	Prairie sandreed	10
				Western wheatgrass	10
				Sideoats grama	10
				Blue grama	10
				Switchgrass	5
				Big bluestem	5
Parshall	Sandy	Favorable	3,400	Prairie sandreed	20
		Normal	2,800	Needleandthread	20
		Unfavorable	2,000	Little bluestem	15
				Western wheatgrass	10
				Blue grama	5
				Big bluestem	5
31 Harmony	Clayey	Favorable	3,100	Western wheatgrass	35
		Normal	2,600	Green needlegrass	30
		Unfavorable	1,800	Sideoats grama	10
				Little bluestem	5
				Big bluestem	5
				Blue grama	5
				Sedge	5
32*:					
Harmony	Clayey	Favorable	3,100	Western wheatgrass	35
		Normal	2,600	Green needlegrass	30
		Unfavorable	1,800	Sideoats grama	10
				Little bluestem	5
				Big bluestem	5
				Blue grama	5
				Sedge	5
Exline	Thin Claypan	Favorable	1,800	Blue grama	30
		Normal	1,500	Western wheatgrass	20
		Unfavorable	900	Buffalograss	10
				Sedge	10
				Needleandthread	5
				Inland saltgrass	5
				Pricklypear	5
37 Straw	Overflow	Favorable	4,800	Big bluestem	40
		Normal	4,000	Western wheatgrass	15
		Unfavorable	2,800	Green needlegrass	10
				Little bluestem	5
				Porcupinegrass	5
				Kentucky bluegrass	5
				Needleandthread	5
				Prairie cordgrass	5
38 Regan	Subirrigated	Favorable	5,500	Big bluestem	60
		Normal	5,000	Sedge	10
		Unfavorable	4,000	Little bluestem	10
				Switchgrass	5
				Indiangrass	5
40A, 40B Mondamin	Clayey	Favorable	3,100	Green needlegrass	45
		Normal	2,600	Western wheatgrass	35
		Unfavorable	1,800	Blue grama	10
				Sedge	5
43C*:					
Wabek	Very Shallow	Favorable	1,600	Needleandthread	35
		Normal	1,300	Blue grama	25
		Unfavorable	800	Threadleaf sedge	20
				Plains muhly	5
				Western wheatgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
43C*:					
Bowdle	Silty	Favorable	2,900	Green needlegrass	30
		Normal	2,400	Western wheatgrass	25
		Unfavorable	1,700	Needleandthread	25
				Blue grama	10
44D Wabek	Very Shallow	Favorable	1,600	Needleandthread	35
		Normal	1,300	Blue grama	25
		Unfavorable	800	Threadleaf sedge	20
				Plains muhly	5
				Western wheatgrass	5
45B*:					
Wabek	Very Shallow	Favorable	1,600	Needleandthread	35
		Normal	1,300	Blue grama	25
		Unfavorable	800	Threadleaf sedge	20
				Plains muhly	5
				Western wheatgrass	5
Lehr	Shallow to Gravel	Favorable	2,200	Needleandthread	35
		Normal	1,800	Western wheatgrass	10
		Unfavorable	1,100	Blue grama	10
				Plains muhly	5
				Green needlegrass	5
52B*:					
Lihen	Sandy	Favorable	3,100	Prairie sandreed	20
		Normal	2,600	Needleandthread	20
		Unfavorable	1,800	Blue grama	10
				Little bluestem	5
				Big bluestem	5
				Western wheatgrass	5
				Sand dropseed	5
Parshall	Sandy	Favorable	3,400	Prairie sandreed	20
		Normal	2,800	Needleandthread	15
		Unfavorable	2,000	Little bluestem	15
				Western wheatgrass	10
				Blue grama	5
				Big bluestem	5
52D Lihen	Sands	Favorable	3,000	Prairie sandreed	30
		Normal	2,500	Little bluestem	28
		Unfavorable	1,800	Sand bluestem	10
				Big bluestem	5
				Needleandthread	5
54B*:					
Tansem	Silty	Favorable	3,200	Western wheatgrass	25
		Normal	2,700	Needleandthread	20
		Unfavorable	1,900	Green needlegrass	20
				Blue grama	5
				Big bluestem	5
Roseglen	Silty	Favorable	3,500	Western wheatgrass	25
		Normal	2,900	Needleandthread	20
		Unfavorable	2,000	Green needlegrass	20
				Blue grama	10
				Big bluestem	5
				Little bluestem	5
55A*:					
Parshall	Sandy	Favorable	3,400	Prairie sandreed	20
		Normal	2,800	Needleandthread	15
		Unfavorable	2,000	Little bluestem	15
				Western wheatgrass	10
				Blue grama	5
				Big bluestem	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
55A*:					
Tally	Sandy	Favorable	3,100	Little bluestem	25
		Normal	2,600	Needleandthread	15
		Unfavorable	1,800	Prairie sandreed	15
				Blue grama	15
				Sideoats grama	10
				Western wheatgrass	5
55B Tally	Sandy	Favorable	3,100	Little bluestem	25
		Normal	2,600	Needleandthread	15
		Unfavorable	1,800	Prairie sandreed	15
				Blue grama	15
				Sideoats grama	10
				Western wheatgrass	5
56D Tansem Variant	Thin Upland	Favorable	2,800	Little bluestem	30
		Normal	2,300	Needleandthread	25
		Unfavorable	1,600	Sideoats grama	15
				Western wheatgrass	15
				Blue grama	10
				Sedge	5
57A*, 57B*:					
Bryant	Silty	Favorable	3,400	Green needlegrass	50
		Normal	2,800	Western wheatgrass	20
		Unfavorable	2,000	Needleandthread	15
				Blue grama	5
				Sedge	5
Grassna	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
57C Bryant	Silty	Favorable	3,400	Green needlegrass	50
		Normal	2,800	Western wheatgrass	20
		Unfavorable	2,000	Needleandthread	15
				Blue grama	5
				Sedge	5
58B*:					
Temvik	Silty	Favorable	3,200	Western wheatgrass	25
		Normal	2,700	Needleandthread	20
		Unfavorable	1,900	Green needlegrass	20
				Blue grama	5
				Sedge	5
Grassna	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
Bearpaw	Clayey	Favorable	3,100	Western wheatgrass	25
		Normal	2,600	Needlegrass	25
		Unfavorable	1,800	Little bluestem	10
				Prairie junegrass	5
				Blue grama	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
62: Hamerly	Limy Subirrigated	Favorable	4,300	Little bluestem	30
		Normal	3,600	Western wheatgrass	10
		Unfavorable	2,800	Big bluestem	10
				Green needlegrass	10
				Needleandthread	10
				Blue grama	5
				Sideoats grama	5
				Sedge	5
64: Grassna	Overflow	Favorable	4,300	Big bluestem	45
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	15
				Sideoats grama	5
				Leadplant	5
				Sedge	5
65: Grail	Overflow	Favorable	4,300	Big bluestem	30
		Normal	3,600	Western wheatgrass	20
		Unfavorable	2,500	Green needlegrass	10
				Sedge	5
72*:					
Ranslo	Subirrigated	Favorable	4,800	Big bluestem	60
		Normal	4,400	Switchgrass	10
		Unfavorable	3,500	Western wheatgrass	10
				Sedge	10
				Kentucky bluegrass	5
Harriet	Saline Lowland	Favorable	3,300	Western wheatgrass	30
		Normal	3,000	Inland saltgrass	15
		Unfavorable	2,400	Alkali cordgrass	10
75*:					
Tonka	Wet Meadow	Favorable	4,700	Slim sedge	20
		Normal	4,300	Wooly sedge	20
		Unfavorable	3,000	Prairie cordgrass	20
				Western wheatgrass	15
				Northern reedgrass	10
Nishon	Closed Depression	Favorable	3,700	Western wheatgrass	55
		Normal	3,400	Sedge	20
		Unfavorable	2,400	Prairie cordgrass	10
				Bluegrass	5
76: Parnell	Shallow Marsh	Favorable	6,600	Slough sedge	35
		Normal	6,000	Rivergrass	30
		Unfavorable	4,800	Prairie cordgrass	15
				American mannagrass	10
				Reedgrass	5
77*:					
Nishon	Closed Depression	Favorable	3,700	Western wheatgrass	55
		Normal	3,400	Sedge	20
		Unfavorable	2,400	Prairie cordgrass	10
				Bluegrass	5
Heil	Closed Depression	Favorable	3,400	Western wheatgrass	75
		Normal	3,100	Sedge	10
		Unfavorable	2,200		
80: Heil	Closed Depression	Favorable	3,400	Western wheatgrass	75
		Normal	3,100	Sedge	10
		Unfavorable	2,200		

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
82: Stirum	Subirrigated	Favorable	4,800	Big bluestem	35
		Normal	4,400	Sedge	15
		Unfavorable	3,500	Western wheatgrass	10
				Prairie cordgrass	10
				Switchgrass	5
				Little bluestem	5
85: Ranslo	Subirrigated	Favorable	4,800	Big bluestem	60
		Normal	4,400	Switchgrass	10
		Unfavorable	3,500	Western wheatgrass	10
				Sedge	10
				Kentucky bluegrass	5
86: Harriet	Saline Lowland	Favorable	3,300	Western wheatgrass	30
		Normal	3,000	Inland saltgrass	15
		Unfavorable	2,400	Alkali cordgrass	10
87: Marysland	Subirrigated	Favorable	5,500	Big bluestem	60
		Normal	5,000	Sedge	10
		Unfavorable	4,000	Little bluestem	10
				Bluegrass	10
				Indiangrass	5
				Switchgrass	5
88: Divide	Limy Subirrigated	Favorable	3,900	Little bluestem	30
		Normal	3,300	Needlegrass	20
		Unfavorable	2,300	Western wheatgrass	10
				Big bluestem	10
				Sideoats grama	5
				Sedge	5
				Blue grama	5
97: Regan	Wetland	Favorable	6,600	Prairie cordgrass	50
		Normal	6,000	Sedge	20
		Unfavorable	4,800	Reedgrass	10
98: Vallers	Subirrigated	Favorable	5,500	Big bluestem	60
		Normal	5,000	Sedge	10
		Unfavorable	4,000	Little bluestem	10
				Switchgrass	5
				Indiangrass	5
				Kentucky bluegrass	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
3A, 3B. Bowdle	---	Ponderosa pine, green ash, Siberian peashrub, Rocky Mountain juniper, Russian-olive, eastern redcedar.	Siberian elm	---	---
5A, 5B. Bowbells	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
6. Arnegard	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
7. Bearden	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
8. Rentill	---	Eastern redcedar, common chokecherry, American plum, Siberian peashrub, lilac, Tatarian honeysuckle, Russian-olive.	Green ash, bur oak, ponderosa pine, Black Hills spruce, Siberian crabapple.	---	---
9A, 9B, 9C. Bearpaw	Lilac, Siberian peashrub, golden currant, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
10----------------- Brantford	---	Ponderosa pine, green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Siberian elm------	---	---
11A*, 11B*:					
Bearpaw----------	Lilac, Siberian peashrub, golden currant, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm------	---	---
Greenway---------	---	Russian-olive, eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry, lilac.	Black Hills spruce, ponderosa pine, green ash, bur oak, Siberian crabapple.	---	---
13E*:					
Zahl.					
Kloten.					
14D.					
Vida					
15A*, 15B*, 15C*: Williams---------	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
15A*, 15B*, 15C*: Bowbells---------	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
16A*, 16B*: Williams---------	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
16A*, 16B*: Bowbells	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
Tonka.					
16C*: Williams	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Bowbells	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
Parnell.					
17B*: Vida	---	Russian-olive, eastern redcedar, Tatarian honeysuckle, common chokecherry, lilac, Siberian peashrub, American plum.	Green ash, ponderosa pine, Black Hills spruce, bur oak, Siberian crabapple.	---	---
Williams	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
17C*: Vida	---	Russian-olive, eastern redcedar, Tatarian honeysuckle, common chokecherry, lilac, Siberian peashrub, American plum.	Green ash, ponderosa pine, Black Hills spruce, bur oak, Siberian crabapple.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
17C*: Williams	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Bowbells	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
17D*: Vida	---	Russian-olive, eastern redcedar, Tatarian honeysuckle, common chokecherry, lilac, Siberian peashrub, American plum.	Green ash, ponderosa pine, Black Hills spruce, bur oak, Siberian crabapple.	---	---
Zahl.					
17E*: Vida.					
Zahill.					
18A*: Williams	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Niobell	Lilac, Siberian peashrub, golden currant, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
20A, 20B Lehr	---	Green ash, ponderosa pine, Russian-olive, Siberian peashrub, eastern redcedar, Rocky Mountain juniper.	Siberian elm	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
21A*:					
Cavour	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian-olive, eastern redcedar.	---	---	---
Miranda.					
22A*:					
Niobell	Lilac, Siberian peashrub, golden currant, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Miranda.					
23A Noonan Variant	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, ponderosa pine.	---	---	---
24A*:					
Niobell	Lilac, Siberian peashrub, golden currant, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Noonan	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
25*:					
Miranda.					
Heil.					
26*:					
Cresbard	Tatarian honeysuckle, Peking cotoneaster.	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
Cavour	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian-olive, eastern redcedar.	---	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
27B*:					
Lehr	---	Green ash, ponderosa pine, Russian-olive, Siberian peashrub, eastern redcedar, Rocky Mountain juniper.	Siberian elm	---	---
Bowdle	---	Ponderosa pine, green ash, Siberian peashrub, Rocky Mountain juniper, Russian-olive, eastern redcedar.	Siberian elm	---	---
29*:					
Exline.					
Harmony	Tatarian honeysuckle, Peking cotoneaster.	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
30*:					
Letcher	Green ash, silver buffaloberry, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, ponderosa pine.	---	---	---
Parshall	---	Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub, Tatarian honeysuckle, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
31 Harmony	Tatarian honeysuckle, Peking cotoneaster.	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
32*:					
Harmony	Tatarian honeysuckle, Peking cotoneaster.	Russian-olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
Exline.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
37. Straw					
38: Regan	Siberian peashrub, American plum.	Black Hills spruce, Siberian crabapple, eastern redcedar, common chokecherry, lilac.	Blue spruce, green ash, ponderosa pine.	Golden willow	Plains cottonwood.
40A, 40B: Mondamin	American plum, lilac, golden currant.	Green ash, ponderosa pine, Russian-olive, eastern redcedar, Rocky Mountain juniper, common chokecherry, Siberian peashrub.	Siberian elm	---	---
43C*:					
Wabek.					
Bowdle	---	Ponderosa pine, green ash, Siberian peashrub, Rocky Mountain juniper, Russian-olive, eastern redcedar.	Siberian elm	---	---
44D. Wabek					
45B*:					
Wabek.					
Lehr	---	Green ash, ponderosa pine, Russian-olive, Siberian peashrub, eastern redcedar, Rocky Mountain juniper.	Siberian elm	---	---
52B*:					
Lihen	Tatarian honeysuckle, silver buffaloberry, lilac.	Eastern redcedar, bur oak, Siberian crabapple, common chokecherry, Siberian peashrub, American plum.	Ponderosa pine, Russian-olive, green ash.	---	---
Parshall	---	American plum, Peking cotoneaster, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub, Tatarian honeysuckle.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
52D-----Lihen	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
54B*:					
Tansem-----	---	Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Black Hills spruce, bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
Roseglen-----	---	Siberian crabapple, common chokecherry, eastern redcedar, Peking cotoneaster, Siberian peashrub, Tatarian honeysuckle, American plum.	Golden willow, Black Hills spruce, green ash, ponderosa pine.	---	Plains cottonwood.
55A*:					
Parshall-----	---	American plum, Peking cotoneaster, Siberian crab-apple, common chokecherry, eastern redcedar, Siberian peashrub, Tatarian honey-suckle.	Golden willow, ponderosa pine. Black Hills spruce, green ash.	---	Plains cottonwood.
Tally-----	Tatarian honeysuckle, silver buffaloberry, lilac.	Eastern redcedar, bur oak, Siberian crabapple, common chokecherry, Siberian peashrub, American plum.	Ponderosa pine, Russian-olive, green ash.	---	---
55B-----Tally	Tatarian honeysuckle, silver buffaloberry, lilac.	Eastern redcedar, bur oak, Siberian crabapple, common chokecherry, Siberian peashrub, American plum.	Ponderosa pine, Russian-olive, green ash.	---	---
56D-----Tansem Variant	Tatarian honeysuckle, eastern redcedar, Siberian peashrub.	Ponderosa pine, Russian-olive, green ash, Rocky Mountain juniper.	Siberian elm-----	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
57A*, 57B*:					
Bryant	---	Russian-olive, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Tatarian honeysuckle, lilac.	Black Hills spruce, ponderosa pine, green ash, bur oak, Siberian crabapple.	---	---
Grassna	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
57C: Bryant	---	Russian-olive, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Tatarian honeysuckle, lilac.	Black Hills spruce, ponderosa pine, green ash, bur oak, Siberian crabapple.	---	---
58B*:					
Temvik	---	Russian-olive, Siberian peashrub, eastern redcedar, lilac, Tatarian honeysuckle, American plum, common chokecherry.	Black Hills spruce, bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
Grassna	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
Bearpaw	Lilac, Siberian peashrub, golden currant, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
62 Hamerly	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
64 Grassna	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
65 Grail	---	Siberian crabapple, common chokecherry, eastern redcedar, Tatarian honeysuckle, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
72*:					
Ranslo	Siberian peashrub, American plum.	Black Hills spruce, Siberian crabapple, eastern redcedar, common chokecherry, lilac.	Blue spruce, green ash, ponderosa pine.	Golden willow	Plains cottonwood.
Harriet.					
75*:					
Tonka.					
Nishon.					
76. Parnell					
77*:					
Nishon.					
Heil.					
80. Heil					
82. Stirum					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
85. Ranslo	Siberian peashrub, American plum.	Black Hills spruce, Siberian crabapple, eastern redcedar, common chokecherry, lilac.	Blue spruce, green ash, ponderosa pine.	Golden willow	Plains cottonwood.
86. Harriet					
87. Marysland	Siberian peashrub, American plum.	Black Hills spruce, Siberian crabapple, eastern redcedar, common chokecherry, lilac.	Blue spruce, green ash, ponderosa pine.	Golden willow	Plains cottonwood.
88. Divide	---	Tatarian honeysuckle, Siberian crabapple, eastern redcedar, common chokecherry, Siberian peashrub, American plum, Peking cotoneaster.	Golden willow, ponderosa pine, Black Hills spruce, green ash.	---	Plains cottonwood.
97. Regan					
98. Vallers	Siberian peashrub, American plum.	Black Hills spruce, Siberian crabapple, eastern redcedar, common chokecherry, lilac.	Blue spruce, green ash, ponderosa pine.	Golden willow	Plains cottonwood.
99*. Pits					
100. Parnell					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
3A, 3B------------- Bowdle	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.
5A----------------- Bowbells	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
5B----------------- Bowbells	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
6------------------ Arnegard	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
7------------------ Bearden	Good	Good	Fair	Good	Poor	Poor	Good	Poor	Fair.
8------------------ Rentill	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
9A----------------- Bearpaw	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
9B----------------- Bearpaw	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
9C----------------- Bearpaw	Poor	Fair	Good	Fair	Very poor	Very poor	Poor	Very poor	Good.
10----------------- Brantford	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
11A*:									
Bearpaw-----------	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
Greenway----------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
11B*:									
Bearpaw-----------	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Greenway----------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
13E*:									
Zahl--------------	Very poor	Fair	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
Kloten------------	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
14D---------------- Vida	Very poor	Very poor	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
15A*, 15B*:									
Williams----------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Bowbells----------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
15C*:									
Williams----------	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Fair.
Bowbells----------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
16A*, 16B*:									
Williams----------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Bowbells----------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Tonka-------------	Poor	Poor	Fair	Poor	Fair	Fair	Poor	Fair	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
16C*:									
Williams	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Bowbells	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Parnell	Very poor	Poor	Fair	Poor	Fair	Fair	Very poor	Fair	Fair.
17B*:									
Vida	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Williams	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
17C*:									
Vida	Poor	Good	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Williams	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Bowbells	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
17D*:									
Vida	Poor	Good	Good	Poor	Very poor	Very poor	Poor	Very poor	Good.
Zahl	Very poor	Fair	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
17E*:									
Vida	Very poor	Fair	Good	Poor	Very poor	Very poor	Very poor	Very poor	Good.
Zahill	Very poor	Fair	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
18A*:									
Williams	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Niobell	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
20A, 20B Lehr	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
21A*:									
Cavour	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Miranda	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
22A*:									
Niobell	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Miranda	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
23A Noonan Variant	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
24A*:									
Niobell	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Noonan	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
25*:									
Miranda	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Heil	Very poor	Poor	Poor	Poor	Fair	Fair	Very poor	Fair	Poor.
26*:									
Cresbard	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
Cavour	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
27B*:									
Lehr	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Bowdle	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.
29*:									
Exline	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Harmony	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
30*:									
Letcher	Poor	Fair	Good	Fair	Very poor	Very poor	Poor	Very poor	Good.
Parshall	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
31 Harmony	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
32*:									
Harmony	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
Exline	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
37 Straw	Very poor	Good	Fair	Poor	Very poor	Poor	Poor	Very poor	Fair.
38 Regan	Poor	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
40A Mondamin	Good	Fair	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
40B Mondamin	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
43C*:									
Wabek	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Bowdle	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.
44D Wabek	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
45B*:									
Wabek	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Lehr	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
52B*:									
Lihen	Poor	Fair	Good	Fair	Very poor	Very poor	Poor	Very poor	Good.
Parshall	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
52D Lihen	Very poor	Fair	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
54B*:									
Tansem	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Roseglen	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
55A*:									
Parshall	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Tally	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
55B Tally	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
56D----------------- Tansem Variant	Very poor	Fair	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair.
57A*:									
Bryant-------------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Grassna------------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
57B*:									
Bryant-------------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Grassna------------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
57C----------------- Bryant	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
58B*:									
Temvik-------------	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Grassna------------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Bearpaw------------	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
62------------------ Hamerly	Good	Good	Fair	Good	Poor	Poor	Good	Poor	Fair.
64------------------ Grassna	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
65------------------ Grail	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
72*:									
Ranslo-------------	Fair	Poor	Fair	Good	Poor	Poor	Fair	Poor	Fair.
Harriet------------	Very poor	Poor	Fair	Poor	Poor	Poor	Very poor	Poor	Fair.
75*:									
Tonka--------------	Poor	Poor	Fair	Poor	Fair	Fair	Poor	Fair	Fair.
Nishon-------------	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Fair	Poor.
76------------------ Parnell	Very poor	Poor	Fair	Poor	Fair	Fair	Very poor	Fair	Fair.
77*:									
Nishon-------------	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Fair	Poor.
Heil---------------	Very poor	Poor	Poor	Poor	Fair	Fair	Very poor	Fair	Poor.
80------------------ Heil	Very poor	Poor	Poor	Poor	Fair	Fair	Very poor	Fair	Poor.
82------------------ Stirum	Very poor	Poor	Fair	Poor	Fair	Fair	Very poor	Fair	Fair.
85------------------ Ranslo	Fair	Good	Fair	Good	Poor	Poor	Good	Poor	Fair.
86------------------ Harriet	Very poor	Poor	Fair	Poor	Poor	Poor	Very poor	Poor	Fair.
87------------------ Marysland	Poor	Poor	Fair	Good	Fair	Fair	Poor	Fair	Good.
88------------------ Divide	Fair	Fair	Fair	Good	Poor	Poor	Fair	Poor	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
97------------------ Regan	Very poor	Poor	Fair	Poor	Fair	Fair	Very poor	Fair	Fair.
98------------------ Vallers	Poor	Poor	Fair	Good	Fair	Fair	Poor	Fair	Fair.
99*. Pits									
100----------------- Parnell	Very poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Good	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
3A Bowdle	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
3B Bowdle	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
5A Bowbells	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.
5B Bowbells	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
6 Arnegard	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
7 Bearden	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.
8 Rentill	Slight	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
9A, 9B, 9C Bearpaw	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
10 Brantford	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
11A*, 11B*:					
Bearpaw	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Greenway	Moderate: too clayey.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength.
13E*:					
Zahl	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Kloten	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
14D Vida	Moderate: slope, large stones.	Moderate: shrink-swell, slope, large stones.	Moderate: slope, shrink-swell, large stones.	Severe: slope, large stones.	Severe: low strength.
15A*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Bowbells	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
15B*, 15C*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Bowbells	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.
16A*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Bowbells	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.
Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.
16B*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Bowbells	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.
Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.
16C*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Bowbells	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.
Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.
17B*:					
Vida	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
17C*:					
Vida	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
17C*:					
Williams	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Bowbells	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods, frost action.
17D*:					
Vida	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Zahl	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
17E*:					
Vida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Zahill	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
18A*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Niobell	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.
20A Lehr	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
20B Lehr	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
21A*:					
Cavour	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Miranda	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
22A*:					
Niobell	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.
Miranda	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
23A Noonan Variant	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
24A*:					
Niobell	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.
Noonan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
25*:					
Miranda	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Heil	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
26*:					
Cresbard	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Cavour	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
27B*:					
Lehr	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Bowdle	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
29*:					
Exline	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell:
Harmony	Slight	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
30*:					
Letcher	Moderate: wetness.	Slight	Moderate: wetness, shrink-swell.	Slight	Moderate: frost action.
Parshall	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
31 Harmony	Slight	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
32*:					
Harmony	Slight	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Exline	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
37 Straw	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
38 Regan	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, wetness, floods.
40A, 40B Mondamin	Slight	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
43C*:					
Wabek	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Bowdle	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
44D Wabek	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
45B*:					
Wabek	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Lehr	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
52B*:					
Lihen	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Parshall	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
52D Lihen	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
54B*:					
Tansem	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.
Roseglen	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
55A*:					
Parshall	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
Tally	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
55B Tally	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
56D Tansem Variant	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.
57A*:					
Bryant	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.
Grassna	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.
57B*:					
Bryant	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.
Grassna	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
57C: Bryant	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.
58B*:					
Temvik	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
Grassna	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.
Bearpaw	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
62: Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
64: Grassna	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.
65: Grail	Moderate: too clayey, wetness, floods.	Severe: floods, shrink-swell.	Severe: floods.	Severe: floods, shrink-swell.	Severe: low strength, floods, shrink-swell.
72*:					
Ranslo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, frost action, low strength.
Harriet	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.
75*:					
Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.
Nishon	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding.
76: Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.
77*:					
Nishon	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding.
Heil	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
80: Heil	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
82: Stirum	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
85: Ranslo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, frost action, low strength.
86: Harriet	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.
87: Marysland	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.
88: Divide	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: low strength, frost action.
97: Regan	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, wetness, floods.
98: Vallers	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: frost action.
99*. Pits					
100: Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
3A, 3B: Bowdle	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
5A: Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
5B: Bowbells	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
6: Arnegard	Slight	Moderate: seepage.	Slight	Slight	Good.
7: Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
8: Rentill	Severe: percs slowly.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
9A: Bearpaw	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
9B: Bearpaw	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
9C: Bearpaw	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
10: Brantford	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, small stones, too sandy.
11A*:					
Bearpaw	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Greenway	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey, hard to pack.
11B*:					
Bearpaw	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Greenway	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey, hard to pack.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13E*:					
Zahl	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Kloten	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
14D Vida	Severe: percs slowly.	Severe: slope, large stones.	Severe: large stones.	Moderate: slope.	Fair: too clayey, slope, large stones.
15A*:					
Williams	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
15B*:					
Williams	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
15C*:					
Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
16A*:					
Williams	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
16B*:					
Williams	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
16C*:					
Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
16C*:					
Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
17B*:					
Vida	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Williams	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
17C*:					
Vida	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Williams	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Bowbells	Severe: floods, percs slowly.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
17D*:					
Vida	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Zahl	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
17E*:					
Vida	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Zahill	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
18A*:					
Williams	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Niobell	Severe: percs slowly.	Slight	Severe: excess sodium.	Slight	Poor: excess sodium.
20A, 20B Lehr	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
21A*:					
Cavour	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight	Poor: hard to pack, excess sodium.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
21A*:					
Miranda	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight	Poor: excess sodium.
22A*:					
Niobell	Severe: percs slowly.	Slight	Severe: excess sodium.	Slight	Poor: excess sodium.
Miranda	Severe: percs slowly.	Slight	Severe: excess sodium.	Slight	Poor: excess sodium.
23A Noonan Variant	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
24A*:					
Niobell	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight	Poor: excess sodium.
Noonan	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight	Poor: excess sodium.
25*:					
Miranda	Severe: percs slowly.	Slight	Severe: excess sodium.	Slight	Poor: excess sodium.
Heil	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
26*:					
Cresbard	Severe: percs slowly.	Slight	Severe: excess sodium.	Slight	Poor: hard to pack, excess sodium.
Cavour	Severe: percs slowly.	Slight	Severe: excess sodium.	Slight	Poor: hard to pack, excess sodium.
27B*:					
Lehr	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Bowdle	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
29*:					
Exline	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, excess sodium.
Harmony	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
30*:					
Letcher	Severe: wetness, percs slowly.	Severe: seepage.	Severe: excess sodium.	Severe: seepage.	Poor: excess sodium.
Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
31 Harmony	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
32*:					
Harmony	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Exline	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, excess sodium.
37 Straw	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods.	Good.
38 Regan	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
40A Mondamin	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
40B Mondamin	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
43C*:					
Wabek	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage, small stones.
Bowdle	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
44D Wabek	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage, small stones.
45B*:					
Wabek	Severe: poor filter.	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage, small stones.
Lehr	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
52B*:					
Lihen	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
52D Lihen	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
54B*:					
Tansem	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Roseglen	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
55A*:					
Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Tally	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
55B Tally	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
56D Tansem Variant	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
57A*:					
Bryant	Slight	Moderate: seepage.	Slight	Slight	Good.
Grassna	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
57B*:					
Bryant	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Grassna	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
57C Bryant	Slight	Severe: slope.	Slight	Slight	Good.
58B*:					
Temvik	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Grassna	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Bearpaw	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
62 Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
64 Grassna	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
65 Grail	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods.	Severe: floods.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
72*:					
Ranslo	Severe: percs slowly, floods, wetness.	Slight	Severe: floods, wetness, excess sodium.	Severe: floods, wetness.	Poor: wetness, hard to pack, excess sodium.
Harriet	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness, excess sodium.
75*:					
Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Nishon	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
76 Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
77*:					
Nishon	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Heil	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
80 Heil	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
82 Stirum	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding, too sandy, excess sodium.	Severe: seepage, ponding.	Poor: too sandy, ponding, excess sodium.
85 Ranslo	Severe: percs slowly, floods, wetness.	Slight	Severe: floods, wetness, excess sodium.	Severe: floods, wetness.	Poor: wetness, hard to pack, excess sodium.
86 Harriet	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness, excess sodium.
87 Marysland	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
88 Divide	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
97. Regan	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
98. Vallers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
99*. Pits					
100. Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
3A, 3B----------------- Bowdle	Good------------------	Probable-------------	Probable-------------	Fair: area reclaim.
5A, 5B----------------- Bowbells	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
6---------------------- Arnegard	Good------------------	Improbable: excess fines.	Improbable: excess fines.	Good.
7---------------------- Bearden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
8---------------------- Rentill	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
9A, 9B, 9C------------- Bearpaw	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
10--------------------- Brantford	Poor: low strength.	Improbable*----------	Improbable*----------	Poor: area reclaim, small stones.
11A**, 11B**:				
Bearpaw---------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Greenway--------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, too clayey.
13E**:				
Zahl------------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Kloten----------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
14D-------------------- Vida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
15A**, 15B**, 15C**:				
Williams--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Bowbells--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
16A**, 16B**:				
Williams--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Bowbells--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Tonka-----------------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

See footnotes at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
16C**:				
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Bowbells	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Parnell	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
17B**:				
Vida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
17C**:				
Vida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Bowbells	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
17D**:				
Vida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Zahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
17E**:				
Vida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Zahill	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
18A**:				
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Niobell	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
20A, 20B Lehr	Good	Probable	Probable	Poor: small stones, area reclaim.
21A**:				
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.

See footnotes at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
21A**:				
Miranda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
22A**:				
Niobell	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Miranda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
23A Noonan Variant	Good	Probable	Improbable: too sandy.	Poor: excess sodium.
24A**:				
Niobell	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Noonan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
25**:				
Miranda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Heil	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
26**:				
Cresbard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
27B**:				
Lehr	Good	Probable	Probable	Poor: small stones, area reclaim.
Bowdle	Good	Probable	Probable	Fair: area reclaim.
29**:				
Exline	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Harmony	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
30**:				
Letcher	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
31 Harmony	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
32**:				
Harmony	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.

See footnotes at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
32**:				
Exline	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
37 Straw	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
38 Regan	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
40A, 40B Mondamin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
43C**:				
Wabek	Good	Probable	Probable	Poor: small stones, area reclaim.
Bowdle	Good	Probable	Probable	Fair: area reclaim.
44D Wabek	Good	Probable	Probable	Poor: small stones, area reclaim.
45B**:				
Wabek	Good	Probable	Probable	Poor: small stones, area reclaim.
Lehr	Good	Probable	Probable	Poor: small stones, area reclaim.
52B**:				
Lihen	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
52D Lihen	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
54B**:				
Tansem	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Roseglen	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
55A**:				
Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Tally	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
55B Tally	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.

See footnotes at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
56D------------------- Tansem Variant	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer, slope.
57A**, 57B**:				
Bryant---------------	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Grassna--------------	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
57C------------------ Bryant	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
58B**:				
Temvik---------------	Fair. low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Grassna--------------	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Bearpaw--------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
62------------------- Hamerly	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
64------------------- Grassna	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
65------------------- Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
72**:				
Ranslo---------------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Harriet--------------	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
75**:				
Tonka----------------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Nishon---------------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
76------------------- Parnell	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
77**:				
Nishon---------------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

See footnotes at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
77**:				
Heil	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
80 Heil	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
82 Stirum	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
85 Ranslo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
86 Harriet	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
87 Marysland	Fair: wetness.	Probable	Probable	Fair: area reclaim, thin layer.
88 Divide	Fair: wetness.	Probable	Probable	Poor: area reclaim.
97 Regan	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
98 Vallers	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair. small stones.
99**. Pits				
100 Parnell	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

* This soil is an improbable source of sand and gravel for use as construction material because the content of shale fragments is more than 35 percent in the underlying material.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
3A: Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
3B: Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
5A: Bowbell	Slight	Slight	Deep to water	Floods	Erodes easily	Erodes easily.
5B: Bowbells	Moderate: slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
6: Arnegard	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
7: Bearden	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
8: Rentill	Severe: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly	Erodes easily, percs slowly.	Erodes easily, percs slowly.
9A: Bearpaw	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
9B, 9C: Bearpaw	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
10: Brantford	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Too sandy	Droughty.
11A*:						
Bearpaw	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Greenway	Slight	Moderate: hard to pack.	Deep to water	Percs slowly	Erodes easily, percs slowly.	Percs slowly, erodes easily.
11B*:						
Bearpaw	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Greenway	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Percs slowly, erodes easily.
13E*:						
Zahl	Severe: slope.	Slight	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Kloten	Severe: depth to rock, slope.	Severe: piping, thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
14D: Vida	Severe: slope.	Severe: large stones.	Deep to water	Slope, large stones.	Slope, large stones.	Slope, large stones.
15A*:						
Williams	Slight	Slight	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
Bowbells	Slight	Slight	Deep to water	Floods	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
15B*, 15C*:						
Williams	Moderate: slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Bowbells	Slight	Slight	Deep to water	Floods	Erodes easily	Erodes easily.
16A*:						
Williams	Slight	Slight	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
Bowbells	Slight	Slight	Deep to water	Floods	Erodes easily	Erodes easily.
Tonka	Slight	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
16B*:						
Williams	Moderate: slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Bowbells	Slight	Slight	Deep to water	Floods	Erodes easily	Erodes easily.
Tonka	Slight	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
16C*:						
Williams	Moderate: slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Bowbells	Slight	Slight	Deep to water	Floods	Erodes easily	Erodes easily.
Parnell	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
17B*:						
Vida	Moderate: slope.	Slight	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Williams	Moderate: slope.	Slight	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
17C*:						
Vida	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Williams	Severe: slope.	Slight	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily, percs slowly.
Bowbells	Slight	Slight	Deep to water	Floods	Erodes easily	Erodes easily.
17D*:						
Vida	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Zahl	Severe: slope.	Slight	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
17E*:						
Vida	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Zahill	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
18A*:						
Williams	Slight	Slight	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
Niobell	Slight	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
20A Lehr	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Too sandy	Droughty.
20B Lehr	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
21A*:						
Cavour	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily.
Miranda	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium, excess salt.	Percs slowly	Excess sodium, percs slowly.
22A*:						
Niobell	Slight	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
Miranda	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium, excess salt.	Percs slowly	Excess sodium, percs slowly.
23A Noonan Variant	Severe: seepage.	Severe: seepage.	Deep to water	Percs slowly, excess sodium.	Too sandy	Percs slowly, excess sodium.
24A*:						
Niobell	Moderate: slope.	Severe: piping, excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Favorable	Excess sodium, percs slowly.
Noonan	Moderate: slope.	Severe: piping, excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Percs slowly	Excess sodium, percs slowly.
25*:						
Miranda	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium, excess salt.	Percs slowly	Excess sodium, percs slowly.
Heil	Slight	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, excess sodium, percs slowly.
26*:						
Cresbard	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
Cavour	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
27B*:						
Lehr	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
29*:						
Exline	Slight	Severe: excess sodium.	Percs slowly, excess salt, excess sodium.	Percs slowly, excess sodium.	Erodes easily, wetness, percs slowly.	Excess sodium, erodes easily, percs slowly.
Harmony	Slight	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
30*:						
Letcher	Severe: seepage.	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
Parshall	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Too sandy	Favorable.
31 Harmony	Slight	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
32*:						
Harmony	Slight	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Exline	Slight	Severe: excess sodium.	Percs slowly, excess salt, excess sodium.	Percs slowly, excess sodium.	Erodes easily, wetness, percs slowly.	Excess sodium, erodes easily, percs slowly.
37 Straw	Moderate: seepage.	Severe: piping.	Deep to water	Floods	Favorable	Favorable.
38 Regan	Moderate: seepage.	Severe: piping, wetness.	Floods, frost action.	Wetness, floods, excess salt.	Wetness	Wetness.
40A Mondamin	Slight	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
40B Mondamin	Moderate: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
43C*:						
Wabek	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, slope.	Slope, too sandy.	Slope, droughty.
Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
44D Wabek	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, slope.	Slope, too sandy.	Slope, droughty.
45B*:						
Wabek	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, slope.	Too sandy	Droughty.
Lehr	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
52B*:						
Lihen	Severe: seepage.	Severe: piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
52B*:						
Parshall	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
52D Lihen	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
54B*:						
Tansem	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
Roseglen	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
55A*:						
Parshall	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
Tally	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
55B Tally	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
56D Tansem Variant	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope	Slope.
57A*:						
Bryant	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Grassna	Moderate: seepage.	Severe: piping.	Deep to water	Floods	Favorable	Favorable.
57B*:						
Bryant	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Grassna	Moderate: seepage.	Severe: piping.	Deep to water	Floods	Favorable	Favorable.
57C Bryant	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
58B*:						
Temvik	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Grassna	Moderate: seepage.	Severe: piping.	Deep to water	Floods	Favorable	Favorable.
Bearpaw	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
62 Hamerly	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
64 Grassna	Moderate: seepage.	Severe: piping.	Deep to water	Floods	Favorable	Favorable.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
65: Grail	Slight	Moderate: piping.	Deep to water	Floods	Favorable	Favorable.
72*:						
Ranslo	Slight	Severe: wetness, excess sodium.	Percs slowly, floods, frost action.	Percs slowly, wetness, excess sodium.	Wetness, percs slowly.	Excess sodium, wetness.
Harriet	Slight	Severe: piping, wetness, excess sodium.	Percs slowly, floods, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, excess sodium, erodes easily.
75*:						
Tonka	Slight	Severe: ponding.	Ponding, percs slowly. frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Nishon	Slight	Severe: ponding.	Percs slowly, ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
76: Parnell	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
77*:						
Nishon	Slight	Severe: ponding.	Percs slowly, ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Heil	Slight	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, excess sodium, percs slowly.
80: Heil	Slight	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, excess sodium, percs slowly.
82: Stirum	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave, excess sodium.	Ponding, excess sodium, excess salt.	Ponding, too sandy.	Wetness, excess sodium.
85: Ranslo	Slight	Severe: wetness, excess sodium.	Percs slowly, floods, frost action.	Percs slowly, wetness, excess sodium.	Wetness, percs slowly.	Excess sodium, wetness.
86: Harriet	Slight	Severe: piping, wetness, excess sodium.	Percs slowly, floods, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, excess sodium, erodes easily.
87: Marysland	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
88: Divide	Severe: seepage.	Severe: seepage.	Cutbanks cave	Wetness	Wetness, too sandy.	Favorable.
97: Regan	Moderate: seepage.	Severe: piping, wetness.	Floods, frost action.	Wetness, floods, excess salt.	Wetness	Wetness.
98: Vallers	Slight	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
99*. Pits						
100----------------- Parnell	Slight-----------	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
3A, 3B----------- Bowdle	0-7	Loam-------------	ML, CL	A-6, A-4	0	100	95-100	85-95	55-80	30-40	7-15
	7-22	Loam, clay loam	CL, CL	A-4, A-6	0	95-100	95-100	80-95	55-75	30-40	8-15
	22-26	Gravelly loam, gravelly sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	90-100	80-100	60-95	30-60	25-35	5-10
	26-60	Gravelly sand----	SM, SW-SM, SP-SM	A-1, A-2	0-5	60-95	50-85	25-50	5-30	<30	NP-5
5A--------------- Bowbells	0-11	Loam-------------	CL, ML, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-95	60-90	25-45	5-15
	11-25	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
	25-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
5B--------------- Bowbells	0-11	Loam-------------	CL, ML, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-95	60-90	20-45	5-15
	11-25	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	25-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
6---------------- Arnegard	0-13	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-90	20-35	5-20
	13-32	Loam, silt loam, clay loam.	CL	A-6	0	100	100	85-100	50-90	25-40	12-25
	32-60	Loam, clay loam, fine sandy loam.	SM, ML, CL, SC	A-4, A-6	0	100	100	70-100	40-80	15-40	NP-15
7---------------- Bearden	0-6	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	20-40	5-20
	6-33	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
	33-60	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
8---------------- Rentill	0-12	Loam-------------	ML, CL	A-4, A-6	0	100	100	85-95	60-75	30-40	5-15
	12-31	Gravelly loam, loam, fine sandy loam.	ML, SM	A-4, A-2	0-5	80-100	70-95	40-90	25-70	20-35	NP-10
	31-60	Clay, clay loam, silty clay.	CL, CH	A-7	0	95-100	90-100	85-100	70-95	40-65	15-35
9A, 9B, 9C------- Bearpaw	0-5	Loam-------------	ML, CL	A-4, A-6, A-7	0-5	90-100	80-100	70-95	50-75	30-45	10-20
	5-20	Clay loam, clay	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	60-90	40-65	15-40
	20-42	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	55-85	35-60	15-35
	42-60	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	55-85	35-60	15-35
10--------------- Brantford	0-7	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-100	80-90	60-80	15-35	3-15
	7-16	Clay loam--------	CL	A-6, A-7	0	90-100	85-100	75-100	50-80	30-50	10-25
	16-60	Gravelly sand*---	SM, GP-GM, SP-SM, GM	A-1, A-2, A-7	5-20	50-95	30-95	15-65	10-45	25-60	NP-20
11A**, 11B**:											
Bearpaw---------	0-5	Loam-------------	ML, CL	A-4, A-6, A-7	0-5	90-100	80-100	70-95	50-75	30-45	10-20
	5-20	Clay loam, clay	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	60-90	40-65	15-40
	20-42	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	55-85	35-60	15-35
	42-60	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	55-85	35-60	15-35
Greenway--------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	25-40	5-15
	8-16	Clay loam, loam	CL	A-6	0-5	90-100	85-100	80-100	60-80	30-50	10-25
	16-19	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4	0-5	90-100	85-100	60-100	30-55	15-30	NP-10
	19-33	Clay loam, clay	CL, CH	A-7	0-5	90-100	80-100	70-100	55-85	40-60	15-30
	33-60	Clay loam--------	CL, CH	A-6, A-7	0-5	90-100	80-100	70-100	55-85	35-60	12-30

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
13E**:											
Zahl	0-6	Loam	CL, ML	A-6, A-7	0-5	95-100	95-100	80-95	50-75	25-45	10-20
	6-26	Loam	CL	A-6, A-7	0-5	90-100	90-100	80-95	60-80	25-45	10-20
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	90-100	80-95	60-80	25-45	10-20
Kloten	0-14	Loam	CL, CL-ML	A-4, A-6	0-10	90-100	90-100	85-95	60-80	20-40	5-20
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
14D: Vida	0-4	Extremely stony loam.	CL-ML, SM-SC	A-4	30-45	80-100	75-90	60-80	45-65	20-30	5-10
	4-21	Clay loam, loam	CL	A-6	5-30	90-100	85-100	70-95	50-85	30-40	10-20
	21-60	Clay loam, loam	CL	A-6	5-30	90-100	85-100	70-95	50-80	25-40	10-20
15A**, 15B**, 15C**:											
Williams	0-6	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-25	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	25-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Bowbells	0-11	Loam	CL, ML, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-95	60-90	25-45	5-15
	11-25	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
	25-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
16A**, 16B**:											
Williams	0-6	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-25	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	25-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Bowbells	0-11	Loam	CL, ML, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-95	60-90	25-45	5-15
	11-25	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
	25-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
Tonka	0-12	Silt loam, loam	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	12-42	Silty clay, silty clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	42-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	30-50	10-30
16C**:											
Williams	0-6	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-25	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	25-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Bowbells	0-11	Loam	CL, ML, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-95	60-90	25-45	5-15
	11-25	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
	25-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
Parnell	0-7	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-60	15-30
	7-45	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
	45-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
17B**:											
Vida	0-4	Loam	CL-ML	A-4	0-10	90-100	85-95	70-90	55-75	20-30	5-10
	4-21	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-85	30-40	10-20
	21-60	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-80	25-40	10-20
Williams	0-6	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-25	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	25-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
17C**:											
Vida	0-4	Loam	CL-ML	A-4	0-10	90-100	85-95	70-90	55-75	20-30	5-10
	4-21	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-85	30-40	10-20
	21-60	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-80	25-40	10-20
Williams	0-6	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-25	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	25-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Bowbells	0-11	Loam	CL, ML, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-95	60-90	25-45	5-15
	11-25	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
	25-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	30-45	10-20
17D**:											
Vida	0-4	Loam	CL-ML	A-4	0-10	90-100	85-95	70-90	55-75	20-30	5-10
	4-21	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-85	30-40	10-20
	21-60	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-80	25-40	10-20
Zahl	0-6	Loam	CL, ML	A-6, A-7	0-5	95-100	95-100	80-95	50-75	25-45	10-20
	6-26	Loam	CL	A-6, A-7	0-5	90-100	90-100	80-95	60-80	25-45	10-20
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	90-100	80-95	60-80	25-45	10-20
17E**:											
Vida	0-4	Loam	CL-ML	A-4	0-10	90-100	85-95	70-90	55-75	20-30	5-10
	4-21	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-85	30-40	10-20
	21-60	Clay loam, loam	CL	A-6	0-10	90-100	85-100	70-95	50-80	25-40	10-20
Zahill	0-3	Loam	CL-ML, ML	A-4	0-10	90-100	85-95	80-90	60-75	20-30	NP-10
	3-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-10	90-100	90-100	80-95	60-80	25-45	10-20
18A**:											
Williams	0-6	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-25	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	25-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Niobell	0-13	Loam	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	3-18
	13-26	Clay loam, loam	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	50-80	30-60	15-35
	26-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	25-40	3-18
20A, 20B Lehr	0-5	Loam	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-80	20-40	3-15
	5-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	25-40	5-15
	15-60	Gravelly sand	SM, SP, GM, GP	A-1	0-5	40-70	25-50	10-35	2-15	<30	NP-7
21A**:											
Cavour	0-11	Loam	ML, CL, MH	A-4, A-6, A-7	0-1	100	95-100	85-100	60-85	30-55	5-20
	11-32	Clay, clay loam, silty clay loam.	CL, CH, MH, ML	A-7	0-5	100	95-100	90-100	70-95	40-65	15-30
	32-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	95-100	85-100	60-85	35-65	12-35
Miranda	0-2	Loam	CL-ML, CL, ML	A-4, A-6	0	100	100	85-95	60-85	25-40	5-15
	2-9	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-20
	9-60	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-20
22A**:											
Niobell	0-13	Loam	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	3-18
	13-26	Clay loam, loam	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	50-80	30-60	15-35
	26-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	25-40	3-18

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
22A**:											
Miranda---------	0-2	Loam-------------	CL-ML, CL, ML	A-4, A-6	0	100	100	85-95	60-85	25-40	5-15
	2-9	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-20
	9-60	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-20
23A-------------- Noonan Variant	0-9	Loam-------------	ML, CL	A-4, A-6	0	100	100	90-100	50-70	30-40	5-15
	9-12	Loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	35-55	20-35	3-10
	12-22	Clay loam--------	CL	A-6, A-7	0	100	95-100	90-100	55-70	30-45	10-20
	22-26	Loam, sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	35-55	20-35	3-10
	26-41	Loamy fine sand, loamy sand, sandy loam.	SM	A-2, A-4	0	100	95-100	85-100	20-40	<30	NP-5
	41-60	Gravelly sand, shaly sand, gravel.	SM, SW-SM, SM-SC	A-1, A-2	0	95-100	55-75	40-70	5-35	<25	NP-5
24A**:											
Niobell---------	0-13	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	3-18
	13-26	Clay loam, loam	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	50-80	30-60	15-35
	26-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	25-40	3-18
Noonan----------	0-9	Loam-------------	CL, CL-ML	A-4, A-6	0-1	95-100	95-100	80-95	55-75	20-40	5-25
	9-28	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	85-95	65-80	25-60	10-35
	28-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	95-100	95-100	80-95	60-80	25-50	10-25
25**:											
Miranda---------	0-2	Loam-------------	CL-ML, CL, ML	A-4, A-6	0	100	100	85-95	60-85	25-40	5-15
	2-9	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-20
	9-60	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-20
Heil------------	0-2	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
	2-26	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
	26-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	85-100	60-95	25-60	11-45
26**:											
Cresbard--------	0-10	Loam-------------	ML, CL	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	10-20	Clay loam, silty clay, clay.	CL, CH	A-7	0-5	100	100	90-100	70-90	40-60	15-30
	20-26	Clay loam, silty clay, clay.	CL, CH	A-7	0-5	100	100	85-100	70-90	40-60	15-30
	26-60	Clay loam, loam	CL, CH, ML	A-6, A-7	0-5	100	100	85-100	60-80	35-55	10-27
Cavour----------	0-11	Loam-------------	ML, CL, MH	A-4, A-6, A-7	0-1	100	95-100	85-100	60-85	30-55	5-20
	11-32	Clay, clay loam, silty clay loam.	CL, CH, MH, ML	A-7	0-5	100	95-100	90-100	70-95	40-65	15-30
	32-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	95-100	85-100	60-85	35-65	12-35
27B**:											
Lehr------------	0-5	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-80	20-40	3-15
	5-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	25-40	5-15
	15-60	Gravelly sand----	SM, SP, GM, GP	A-1	0-5	40-70	25-50	10-35	2-15	<30	NP-7

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
27B**:											
Bowdle	0-7	Loam	ML, CL	A-6, A-4	0	100	95-100	85-95	55-80	30-40	7-15
	7-22	Loam, clay loam	CL, CL	A-4, A-6	0	95-100	95-100	80-95	55-75	30-40	8-15
	22-26	Gravelly loam, gravelly sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	90-100	80-100	60-95	30-60	25-35	5-10
	26-60	Gravelly sand	SM, SW-SM, SP-SM	A-1, A-2	0-5	60-95	50-85	25-50	5-30	<30	NP-5
29**:											
Exline	0-2	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	2-19	Clay, silty clay, silty clay loam.	MH, CH	A-7	0	100	100	95-100	90-100	60-90	30-50
	19-43	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	95-100	85-100	50-80	20-45
	43-60	Clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
Harmony	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	8-23	Silty clay, silty clay loam.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	40-65	15-32
	23-60	Silty clay loam, silt loam, silty clay.	ML, CL, CH, MH	A-6, A-7	0	100	100	95-100	90-100	25-50	5-25
30**:											
Letcher	0-9	Loam	CL, ML	A-4, A-6	0	100	100	75-95	50-70	25-40	3-15
	9-19	Fine sandy loam, loamy fine sand.	SM	A-2, A-4	0	100	100	60-95	20-40	<30	NP-7
	19-25	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-2, A-4, A-6	0	100	100	60-95	30-60	25-40	3-15
	25-41	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-2, A-4, A-6	0	100	100	50-95	20-55	24-40	3-19
	41-60	Clay loam, loam	CL, ML	A-4, A-6, A-7	0	100	95-100	75-100	50-75	30-45	8-28
Parshall	0-9	Loam	ML	A-4	0	100	100	85-95	60-75	20-40	NP-10
	9-60	Fine sandy loam, sandy loam, loamy fine sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	<30	NP-5
31 Harmony	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	8-23	Silty clay, silty clay loam.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	40-65	15-32
	23-60	Silty clay loam, silt loam, silty clay.	ML, CL, CH, MH	A-6, A-7	0	100	100	95-100	90-100	25-50	5-25
32**:											
Harmony	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	8-23	Silty clay, silty clay loam.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	40-65	15-32
	23-60	Silty clay loam, silt loam, silty clay.	ML, CL, CH, MH	A-6, A-7	0	100	100	95-100	90-100	25-55	5-25
Exline	0-2	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	2-19	Clay, silty clay, silty clay loam.	MH, CH	A-7	0	100	100	95-100	90-100	60-90	30-50
	19-43	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	95-100	85-100	50-80	20-45
	43-60	Clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
37 Straw	0-15	Loam	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	15-60	Stratified loamy sand to silt loam.	ML, CL, SM, SC	A-4, A-6	0	100	100	85-100	45-85	25-40	5-15

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
38: Regan	0-23	Silt loam	CL, CL-ML	A-7, A-6, A-4	0	100	100	90-100	80-95	20-50	5-30
	23-60	Silt loam, clay loam.	ML, CL	A-7, A-6, A-4	0	100	100	90-100	70-95	30-50	5-30
40A, 40B: Mondamin	0-5	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	5-35	Silty clay, silty clay loam.	CH, MH, ML	A-7	0	100	100	95-100	90-100	40-60	15-28
	35-60	Silty clay loam	CL	A-6, A-7	0	100	95-100	95-100	90-100	30-50	11-25
43C**: Wabek	0-6	Gravelly loam	ML	A-4	0-1	90-100	90-100	75-90	50-70	25-40	NP-10
	6-9	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam.	SM, GM	A-2, A-4	0-5	50-100	50-95	50-65	20-40	<30	NP-7
	9-60	Very gravelly coarse sand, gravelly sand, sand.	SM, SP, GM, GP	A-1, A-2	0-5	50-100	50-95	10-40	2-35	<30	NP-7
Bowdle	0-7	Loam	ML, CL	A-6, A-4	0	100	95-100	85-95	55-80	30-40	7-15
	7-22	Loam, clay loam	CL, CL	A-4, A-6	0	95-100	95-100	80-95	55-75	30-40	8-15
	22-26	Gravelly loam, gravelly sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	90-100	80-100	60-95	30-60	25-35	5-10
	26-60	Gravelly sand	SM, SW-SM, SP-SM	A-1, A-2	0-5	60-95	50-85	25-50	5-30	<30	NP-5
44D: Wabek	0-6	Gravelly loam	ML	A-4	0-1	90-100	90-100	75-90	50-70	25-40	NP-10
	6-9	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam.	SM, GM	A-2, A-4	0-5	50-100	50-95	50-65	20-40	<30	NP-7
	9-60	Very gravelly coarse sand, gravelly sand, sand.	SM, SP, GM, GP	A-1, A-2	0-5	50-100	50-95	10-40	2-35	<30	NP-7
45B**: Wabek	0-6	Gravelly loam	ML	A-4	0-1	90-100	90-100	75-90	50-70	25-40	NP-10
	6-9	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam.	SM, GM	A-2, A-4	0-5	50-100	50-95	50-65	20-40	<30	NP-7
	9-60	Very gravelly coarse sand, gravelly sand, sand.	SM, SP, GM, GP	A-1, A-2	0-5	50-100	50-95	10-40	2-35	<30	NP-7
Lehr	0-5	Loam	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-80	20-40	3-15
	5-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	25-40	5-15
	15-60	Gravelly sand	SM, SP, GM, GP	A-1	0-5	40-70	25-50	10-35	2-15	<30	NP-7
52B**: Lihen	0-15	Fine sandy loam	SM	A-4	0	100	85-100	60-80	35-50	<30	NP-7
	15-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-1	0	100	85-100	45-75	15-35	<30	NP-7
Parshall	0-19	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	<30	NP-7
	19-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	<30	NP-5

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
52D-------------- Lihen	0-15	Loamy fine sand	SM	A-2, A-1	0	100	85-100	45-75	15-30	<30	NP-5
	15-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-1	0	100	85-100	45-75	15-35	<30	NP-5
54B**:											
Tansem----------	0-7	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-23
	7-15	Loam, silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-23
	15-60	Silt loam, loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	70-100	20-40	3-15
Roseglen--------	0-9	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	20-40	3-23
	9-33	Silt loam, loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	20-40	3-23
	33-60	Gravelly sand to clay loam.	SM, SC, ML, CL	A-4, A-6	0	90-100	80-100	70-90	45-80	20-40	3-15
55A**:											
Parshall--------	0-19	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	<30	NP-7
	19-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	<30	NP-5
Tally-----------	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	90-100	80-100	60-100	30-55	20-30	NP-10
	8-28	Fine sandy loam, sandy loam.	SM, SM-SC	A-4, A-2	0	90-100	80-100	50-100	15-50	15-25	NP-10
	28-60	Loamy fine sand, loamy sand, sandy loam.	SM, SM-SC	A-2, A-4, A-1	0	90-100	80-100	45-100	15-45	15-25	NP-10
55B-------------- Tally	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	90-100	80-100	60-100	30-55	20-30	NP-10
	8-28	Fine sandy loam, sandy loam.	SM, SM-SC	A-4, A-2	0	90-100	80-100	50-100	15-50	15-25	NP-10
	28-60	Loamy fine sand, loamy sand, sandy loam.	SM, SM-SC	A-2, A-4, A-1	0	90-100	80-100	45-100	15-45	15-25	NP-10
56D-------------- Tansem Variant	0-7	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-15
	7-24	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-15
	24-60	Stratified very fine sand to silty clay loam.	ML	A-4	0	100	80-100	80-100	50-85	20-40	NP-10
57A**, 57B**:											
Bryant----------	0-7	Silt loam--------	ML, CL, CL-ML	A-6, A-4	0	100	100	85-100	70-100	25-40	3-15
	7-15	Clay loam, silt loam, silty clay loam.	CL, ML, CL-ML	A-6, A-4	0	100	100	85-100	70-100	25-40	3-15
	15-60	Clay loam, loam, silt loam.	CL, ML, CL-ML	A-6, A-4	0	100	100	85-100	70-100	25-40	3-15
Grassna---------	0-16	Silt loam--------	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	25-45	5-20
	16-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	25-45	5-20

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
57C---------------- Bryant	0-7	Silt loam--------	ML, CL, CL-ML	A-6, A-4	0	100	100	85-100	70-100	25-40	3-15
	7-15	Clay loam, silt loam, silty clay loam.	CL, ML, CL-ML	A-6, A-4	0	100	100	85-100	70-100	25-40	3-15
	15-60	Clay loam, loam, silt loam.	CL, ML, CL-ML	A-6, A-4	0	100	100	85-100	70-100	25-40	3-15
58B**:											
Temvik-----------	0-8	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	25-40	2-10
	8-31	Silt loam, silty clay loam, clay loam.	CL	A-6	0	100	100	90-100	70-90	25-40	10-19
	31-60	Clay loam, loam	CL	A-6	0-5	95-100	95-100	80-100	55-80	25-40	10-19
Grassna----------	0-16	Silt loam--------	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	25-45	5-20
	16-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	25-45	5-20
Bearpaw----------	0-5	Loam-------------	ML, CL	A-4, A-6, A-7	0-5	90-100	80-100	70-95	50-75	30-45	10-20
	5-20	Clay loam, clay	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	60-90	40-65	15-40
	20-42	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	55-85	35-60	15-35
	42-60	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0-5	85-100	80-100	70-100	55-85	35-60	15-35
62---------------- Hamerly	0-13	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-25
	13-34	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	34-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
64---------------- Grassna	0-16	Silt loam--------	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	25-45	5-20
	16-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	25-45	5-20
65---------------- Grail	0-6	Silty clay loam	CL	A-4, A-6, A-7	0	100	100	95-100	85-100	30-45	8-20
	6-30	Silty clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	30-60	Silty clay loam	CL	A-6, A-7,	0	100	100	95-100	80-100	30-45	10-20
72**:											
Ranslo-----------	0-15	Loam-------------	CL, CL-ML, ML	A-4, A-6	0	100	100	90-100	70-90	25-40	3-15
	15-28	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	95-100	75-90	40-60	15-30
	28-33	Clay loam, silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	75-95	50-75	23-42
	33-60	Clay loam, silty clay loam, sandy clay loam.	CL, CH	A-6, A-7	0	100	100	85-100	50-90	35-55	12-28
Harriet----------	0-2	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-20
	2-15	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-70	20-40
	15-46	Stratified loam and clay loam.	CL	A-6, A-7	0	100	100	90-100	60-75	30-50	15-30
	46-60	Sandy loam, gravelly loam.	SM, SM-SC, ML, CL-ML	A-4, A-6	0	95-100	80-95	60-80	45-65	25-40	5-15

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
75**:											
Tonka	0-12	Silt loam, loam	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	12-42	Silty clay, silty clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	42-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	30-50	10-30
Nishon	0-7	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	90-100	75-90	25-40	5-15
	7-19	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	75-95	40-65	20-45
	19-60	Clay, silty clay, clay loam.	CL, CH	A-6, A-7	0	90-100	90-100	80-100	65-90	35-60	15-40
76 Parnell	0-7	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-60	15-30
	7-45	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
	45-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
77**:											
Nishon	0-7	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	90-100	75-90	25-40	5-15
	7-19	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	75-95	40-65	20-45
	19-60	Clay, silty clay, clay loam.	CL, CH	A-6, A-7	0	90-100	90-100	80-100	65-90	35-60	15-40
Heil	0-2	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
	2-26	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
	26-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	85-100	60-95	25-60	11-45
80 Heil	0-2	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
	2-26	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
	26-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	85-100	60-95	25-60	11-45
82 Stirum	0-6	Loam	ML, CL	A-4, A-6	0	100	100	90-100	50-70	30-40	5-15
	6-8	Fine sandy loam, sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	95-100	85-100	25-45	<30	NP-7
	8-19	Fine sandy loam, sandy clay loam.	SM, SC, SM-SC	A-4	0	100	95-100	85-100	35-50	15-30	NP-10
	19-41	Loamy sand, fine sand.	SM, SM-SC	A-2	0	100	90-100	80-100	15-35	<25	NP-5
	41-60	Clay loam, clay	CL	A-6, A-7	0	100	95-100	85-100	55-75	30-45	10-20
85 Ranslo	0-15	Silt loam	CL, CL-ML, ML	A-4, A-6	0	100	100	90-100	70-90	25-40	3-15
	15-28	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	95-100	75-90	40-60	15-30
	28-33	Clay loam, silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	75-95	50-75	23-42
	33-60	Clay loam, silty clay loam, sandy clay loam.	CL, CH	A-6, A-7	0	100	100	85-100	50-90	35-55	12-28
86 Harriet	0-2	Loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-20
	2-15	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-70	20-40
	15-46	Stratified loam and clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	60-75	30-50	15-30
	46-60	Sandy loam, gravelly loam.	SM, SM-SC, ML, CL-ML	A-4, A-6	0	95-100	80-95	60-80	45-65	25-40	5-15

See footnotes at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
87----------------- Marysland	0-11	Loam---------------	CL	A-6, A-7	0	95-100	95-100	85-95	50-80	30-50	10-25
	11-27	Loam, clay loam, sandy clay loam.	CL, SC	A-6	0	90-100	85-100	80-95	45-80	20-40	10-20
	27-60	Stratified fine sand to gravelly coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	70-95	50-90	35-70	5-20	<30	NP-7
88----------------- Divide	0-8	Loam---------------	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-85	25-40	5-20
	8-30	Loam, clay loam, gravelly loam.	CL, CL-ML	A-4, A-6	0-3	95-100	80-100	60-90	55-80	20-40	5-20
	30-60	Stratified sand to gravelly sand.	GM, SM, GP-GM, SP-SM	A-1	0-5	25-75	15-65	10-40	5-25	<30	NP-7
97----------------- Regan	0-15	Silt loam---------	CL, CL-ML	A-7, A-6, A-4	0	100	100	90-100	80-95	20-50	5-30
	15-60	Stratified sandy loam to silty clay loam.	ML, CL, SC, SM	A-7, A-6, A-4	0	100	100	65-100	35-95	15-50	NP-30
98----------------- Vallers	0-13	Silty clay loam	OL, CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-95	30-50	11-20
	13-36	Clay loam, silty clay loam, sandy clay loam.	CL	A-6	0-5	95-100	90-97	80-95	50-80	30-40	11-20
	36-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-97	85-95	60-75	20-40	5-20
99**. Pits											
100---------------- Parnell	0-7	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-60	15-30
	7-45	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
	45-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50

* The IIC horizon has a high percentage of shale fragments the size of gravel.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	In/hr	In/in	pH	Mmhos/cm					Pct
3A, 3B---------- Bowdle	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low---------	0.28	4	6	3-5
	7-22	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low---------	0.28			
	22-26	0.6-2.0	0.15-0.18	7.4-8.4	<2	Low---------	0.28			
	26-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.10			
5A--------------- Bowbells	0-11	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low---------	0.28	5	6	4-6
	11-25	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate----	0.28			
	25-60	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate----	0.37			
5B--------------- Bowbells	0-11	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low---------	0.28	5	6	2-6
	11-25	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate----	0.28			
	25-60	0.06-0.6	0.14-0.18	7.9-8.4	<2	Moderate----	0.37			
6---------------- Arnegard	0-13	0.6-2.0	0.20-0.24	6.1-7.3	<2	Moderate----	0.28	5	6	3-6
	13-32	0.6-2.0	0.16-0.22	6.6-7.8	<2	Moderate----	0.28			
	32-60	0.6-2.0	0.14-0.18	6.6-8.4	<2	Low---------	0.28			
7---------------- Bearden	0-6	0.6-2.0	0.20-0.24	7.4-8.4	<4	Moderate----	0.28	5	4L	3-7
	6-33	0.2-2.0	0.16-0.22	7.4-8.4	<8	Moderate----	0.28			
	33-60	0.06-2.0	0.16-0.22	7.4-8.4	<8	Moderate----	0.43			
8---------------- Rentill	0-12	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate----	0.28	3	6	3-5
	12-31	2.0-6.0	0.12-0.20	6.6-7.8	<2	Low---------	0.28			
	31-60	0.06-0.6	0.11-0.17	7.9-9.0	<2	High--------	0.37			
9A, 9B, 9C------- Bearpaw	0-5	0.2-0.6	0.16-0.20	6.1-7.8	<2	Moderate----	0.28	5	6	2-5
	5-20	0.2-0.6	0.15-0.18	6.6-8.4	<2	High--------	0.37			
	20-42	0.2-0.6	0.15-0.18	7.4-8.4	2-4	High--------	0.37			
	42-60	0.06-0.2	0.15-0.18	7.4-9.0	2-8	High--------	0.37			
10--------------- Brantford	0-7	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low---------	0.28	3	6	3-6
	7-16	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate----	0.28			
	16-60	>20	0.02-0.05	7.4-8.4	<2	Low---------	0.10			
11A*, 11B*:										
Bearpaw---------	0-5	0.2-0.6	0.16-0.20	6.1-7.8	<2	Moderate----	0.28	5	6	2-5
	5-20	0.2-0.6	0.15-0.18	6.6-8.4	<2	High--------	0.37			
	20-42	0.2-0.6	0.15-0.18	7.4-8.4	2-4	High--------	0.37			
	42-60	0.06-0.2	0.15-0.18	7.4-9.0	2-8	High--------	0.37			
Greenway--------	0-8	0.6-2.0	0.18-0.20	5.6-7.3	<2	Moderate----	0.28	5	6	2-4
	8-16	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate----	0.28			
	16-19	2.0-6.0	0.08-0.18	6.1-7.3	<2	Low---------	0.28			
	19-33	0.06-0.2	0.13-0.19	6.6-7.8	<2	High--------	0.37			
	33-60	0.06-0.2	0.13-0.17	7.4-8.4	2-4	High--------	0.37			
13E*:										
Zahl------------	0-6	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate----	0.28	5	4L	1-3
	6-26	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate----	0.37			
	26-60	0.06-0.6	0.15-0.19	7.4-8.4	<2	Moderate----	0.37			
Kloten----------	0-14	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate----	0.32	2	6	1-3
	14-60	---	---	---	---	------------	----			
14D-------------- Vida	0-4	0.6-2.0	0.10-0.14	6.6-8.4	<2	Low---------	0.28	5	8	1-3
	4-21	0.6-2.0	0.14-0.18	6.6-8.4	<2	Moderate----	0.32			
	21-60	0.2-0.6	0.14-0.18	7.9-9.0	<2	Moderate----	0.32			
15A*, 15B*, 15C*:										
Williams--------	0-6	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low---------	0.28	5	6	2-5
	6-25	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate----	0.28			
	25-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate----	0.37			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	In/hr	In/in	pH	Mmhos/cm					Pct
15A*, 15B*, 15C*:										
Bowbells--------	0-11	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low---------	0.28	5	6	4-6
	11-25	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate----	0.28			
	25-60	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate----	0.37			
16A*, 16B*:										
Williams--------	0-6	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low---------	0.28	5	6	2-5
	6-25	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate----	0.28			
	25-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate----	0.37			
Bowbells--------	0-11	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low---------	0.28	5	6	4-6
	11-25	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate----	0.28			
	25-60	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate----	0.37			
Tonka-----------	0-12	0.6-2.0	0.18-0.23	5.6-7.3	<2	Low---------	0.32	5	6	5-10
	12-42	0.06-0.2	0.14-0.19	5.6-7.8	<2	High--------	0.43			
	42-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate----	0.43			
16C*:										
Williams--------	0-6	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low---------	0.28	5	6	2-5
	6-25	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate----	0.28			
	25-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate----	0.37			
Bowbells--------	0-11	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low---------	0.28	5	6	4-6
	11-25	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate----	0.28			
	25-60	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate----	0.37			
Parnell---------	0-7	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate----	0.28	5	7	6-10
	7-45	0.06-0.2	0.13-0.19	6.6-7.8	<2	High--------	0.28			
	45-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High--------	0.28			
17B*:										
Vida------------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<2	Low---------	0.28	5	6	1-3
	4-21	0.6-2.0	0.14-0.18	6.6-8.4	<2	Moderate----	0.28			
	21-60	0.2-0.6	0.14-0.18	7.9-9.0	<2	Moderate----	0.28			
Williams--------	0-6	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low---------	0.28	5	6	2-5
	6-25	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate----	0.28			
	25-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate----	0.37			
17C*:										
Vida------------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<2	Low---------	0.28	5	6	1-3
	4-21	0.6-2.0	0.14-0.18	6.6-8.4	<2	Moderate----	0.28			
	21-60	0.2-0.6	0.14-0.18	7.9-9.0	<2	Moderate----	0.28			
Williams--------	0-6	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low---------	0.28	5	6	2-5
	6-25	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate----	0.28			
	25-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate----	0.37			
Bowbells--------	0-11	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low---------	0.28	5	6	4-6
	11-25	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate----	0.28			
	25-60	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate----	0.37			
17D*:										
Vida------------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<2	Low---------	0.28	5	6	1-3
	4-21	0.6-2.0	0.14-0.18	6.6-8.4	<2	Moderate----	0.28			
	21-60	0.2-0.6	0.14-0.18	7.9-9.0	<2	Moderate----	0.28			
Zahl------------	0-6	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate----	0.28	5	4L	1-3
	6-26	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate----	0.37			
	26-60	0.06-0.6	0.15-0.19	7.4-8.4	<2	Moderate----	0.37			
17E*:										
Vida------------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<2	Low---------	0.28	5	6	1-3
	4-21	0.6-2.0	0.14-0.18	6.6-8.4	<2	Moderate----	0.28			
	21-60	0.2-0.6	0.14-0.18	7.9-9.0	<2	Moderate----	0.28			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	In/hr	In/in	pH	Mmhos/cm					Pct
17E*:										
Zahill----------	0-3	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low---------	0.28	5	4L	.5-1
	3-60	0.2-0.6	0.14-0.18	7.4-9.0	<2	Moderate----	0.28			
18A*:										
Williams--------	0-6	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low---------	0.28	5	6	2-5
	6-25	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate----	0.28			
	25-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate----	0.37			
Niobell---------	0-13	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate----	0.32	3	6	2-4
	13-26	0.06-0.2	0.15-0.19	7.4-8.4	<2	High--------	0.32			
	26-60	0.2-0.6	0.15-0.19	7.9-9.0	2-8	Moderate----	0.32			
20A, 20B--------- Lehr	0-5	2.0-6.0	0.17-0.22	6.6-7.3	<2	Low---------	0.28	3	6	1-3
	5-15	2.0-6.0	0.17-0.20	6.6-7.8	<2	Moderate----	0.28			
	15-60	>6.0	0.02-0.04	7.4-8.4	<2	Low---------	0.10			
21A*:										
Cavour----------	0-11	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate----	0.37	3	6	2-4
	11-32	<0.2	0.10-0.16	6.6-9.0	4-16	High--------	0.37			
	32-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate----	0.37			
Miranda---------	0-2	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low---------	0.32	1	6	1-3
	2-9	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate----	0.32			
	9-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate----	0.32			
22A*:										
Niobell---------	0-13	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate----	0.32	3	6	2-4
	13-26	0.06-0.2	0.15-0.19	7.4-8.4	<2	High--------	0.32			
	26-60	0.2-0.6	0.15-0.19	7.9-9.0	2-8	Moderate----	0.32			
Miranda---------	0-2	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low---------	0.32	1	6	1-3
	2-9	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate----	0.32			
	9-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate----	0.32			
23A-------------- Noonan Variant	0-9	0.6-2.0	0.18-0.20	5.6-7.3	<2	Low---------	0.28	3	6	2-6
	9-12	0.6-2.0	0.14-0.20	6.1-7.3	<2	Low---------	0.28			
	12-22	0.06-0.2	0.14-0.17	6.6-7.8	2-8	Moderate----	0.28			
	22-26	0.6-2.0	0.09-0.18	7.4-8.4	2-8	Low---------	0.28			
	26-41	2.0-20	0.08-0.13	7.4-8.4	2-8	Low---------	0.15			
	41-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.15			
24A*:										
Niobell---------	0-13	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate----	0.32	3	6	2-4
	13-26	0.06-0.2	0.15-0.19	7.4-8.4	<2	High--------	0.32			
	26-60	0.2-0.6	0.15-0.19	7.9-9.0	2-8	Moderate----	0.32			
Noonan----------	0-9	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate----	0.32	3	6	2-4
	9-28	0.06-0.2	0.12-0.14	6.6-9.0	<2	High--------	0.32			
	28-60	0.06-0.2	0.10-0.14	7.9-9.0	2-8	Moderate----	0.32			
25*:										
Miranda---------	0-2	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low---------	0.32	1	6	1-3
	2-9	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate----	0.32			
	9-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate----	0.32			
Heil------------	0-2	<0.06	0.15-0.24	5.6-7.3	<2	Moderate----	0.28	3	7	3-6
	2-26	<0.06	0.13-0.18	6.6-9.0	4-16	High--------	0.28			
	26-60	<0.06	0.13-0.18	7.9-9.0	4-16	High--------	0.28			
26*:										
Cresbard--------	0-10	0.6-2.0	0.17-0.20	5.6-7.3	<2	Low---------	0.32	3	6	2-5
	10-20	0.06-0.6	0.11-0.14	5.6-7.3	2-4	High--------	0.32			
	20-26	0.06-0.6	0.11-0.15	6.1-8.4	2-4	High--------	0.32			
	26-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate----	0.32			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	In/hr	In/in	pH	Mmhos/cm					Pct
26*:										
Cavour----------	0-11	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate----	0.37	3	6	2-4
	11-32	<0.2	0.10-0.16	6.6-9.0	4-16	High--------	0.37			
	32-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate----	0.37			
27B*:										
Lehr------------	0-5	2.0-6.0	0.17-0.22	6.6-7.3	<2	Low---------	0.28	3	6	1-3
	5-15	2.0-6.0	0.17-0.20	6.6-7.8	<2	Moderate----	0.28			
	15-60	>6.0	0.02-0.04	7.4-8.4	<2	Low---------	0.10			
Bowdle----------	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low---------	0.28	4	6	3-5
	7-22	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low---------	0.28			
	22-26	0.6-2.0	0.15-0.18	7.4-8.4	<2	Low---------	0.28			
	26-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.10			
29*:										
Exline----------	0-2	0.6-2.0	0.19-0.22	6.1-7.3	<2	Low---------	0.28	3	6	1-3
	2-19	<0.06	0.10-0.15	6.6-9.0	4-16	High--------	0.28			
	19-43	0.06-0.2	0.14-0.17	7.9-9.0	4-8	High--------	0.43			
	43-60	0.06-0.2	0.14-0.17	7.9-9.0	2-8	Moderate----	0.43			
Harmony---------	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate----	0.28	5	7	4-8
	8-23	0.2-0.6	0.13-0.18	6.6-8.4	<2	High--------	0.28			
	23-60	0.2-0.6	0.11-0.20	7.4-8.4	2-4	Moderate----	0.43			
30*:										
Letcher---------	0-9	0.6-2.0	0.16-0.18	5.1-7.8	<2	Low---------	0.24	3	6	1-3
	9-19	0.6-6.0	0.10-0.15	5.1-7.8	<2	Low---------	0.24			
	19-25	0.06-0.2	0.08-0.14	6.6-9.0	2-8	Low---------	0.24			
	25-41	0.6-6.0	0.11-0.18	7.4-9.0	2-8	Low---------	0.24			
	41-60	0.2-0.6	0.13-0.16	7.4-9.0	2-8	Moderate----	0.24			
Parshall--------	0-9	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low---------	0.28	5	5	1-4
	9-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low---------	0.20			
31--------------- Harmony	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate----	0.28	5	7	4-8
	8-23	0.2-0.6	0.13-0.18	6.6-8.4	<2	High--------	0.28			
	23-60	0.2-0.6	0.11-0.20	7.4-8.4	2-4	Moderate----	0.43			
32*:										
Harmony---------	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate----	0.28	5	7	4-8
	8-23	0.2-0.6	0.13-0.18	6.6-8.4	<2	High--------	0.28			
	23-60	0.2-0.6	0.11-0.20	7.4-8.4	2-4	Moderate----	0.43			
Exline----------	0-2	0.6-2.0	0.19-0.22	6.1-7.3	<2	Low---------	0.28	3	6	1-3
	2-19	<0.06	0.10-0.15	6.6-9.0	4-16	High--------	0.28			
	19-43	0.06-0.2	0.14-0.17	7.9-9.0	4-8	High--------	0.43			
	43-60	0.06-0.2	0.14-0.17	7.9-9.0	2-8	Moderate----	0.43			
37--------------- Straw	0-15	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low---------	0.32	5	6	3-5
	15-60	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate----	0.32			
38--------------- Regan	0-23	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate----	0.32	5	4L	2-8
	23-60	0.2-2.0	0.14-0.17	7.9-9.0	<8	Moderate----	0.32			
40A, 40B--------- Mondamin	0-5	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate----	0.37	5	7	2-4
	5-35	0.06-0.6	0.13-0.18	6.6-8.4	<2	High--------	0.37			
	35-60	0.06-0.6	0.17-0.20	7.4-8.4	<2	Moderate----	0.37			
43C*:										
Wabek-----------	0-6	2.0-6.0	0.20-0.22	6.6-7.8	<2	Low---------	0.28	2	5	1-2
	6-9	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low---------	0.10			
	9-60	>20	0.02-0.04	7.4-7.8	<2	Low---------	0.10			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	In/hr	In/in	pH	Mmhos/cm					Pct
43C*:										
Bowdle	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28	4	6	3-5
	7-22	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28			
	22-26	0.6-2.0	0.15-0.18	7.4-8.4	<2	Low	0.28			
	26-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low	0.10			
44D Wabek	0-6	2.0-6.0	0.20-0.22	6.6-7.8	<2	Low	0.28	2	5	1-2
	6-9	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	0.10			
	9-60	>20	0.02-0.04	7.4-7.8	<2	Low	0.10			
45B*:										
Wabek	0-6	2.0-6.0	0.20-0.22	6.6-7.8	<2	Low	0.28	2	5	1-2
	6-9	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	0.10			
	9-60	>20	0.02-0.04	7.4-7.8	<2	Low	0.10			
Lehr	0-5	2.0-6.0	0.17-0.22	6.6-7.3	<2	Low	0.28	3	6	1-3
	5-15	2.0-6.0	0.17-0.20	6.6-7.8	<2	Moderate	0.28			
	15-60	>6.0	0.02-0.04	7.4-8.4	<2	Low	0.10			
52B*:										
Lihen	0-15	6.0-20	0.12-0.16	6.6-7.8	<2	Low	0.20	5	3	1-2
	15-60	6.0-20	0.07-0.11	6.6-7.8	<2	Low	0.17			
Parshall	0-19	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low	0.20	5	3	1-4
	19-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low	0.20			
52D Lihen	0-15	6.0-20	0.08-0.12	6.6-7.8	<2	Low	0.17	5	2	1-2
	15-60	6.0-20	0.07-0.11	6.6-7.8	<2	Low	0.17			
54B*:										
Tansem	0-7	0.6-2.0	0.20-0.22	6.6-7.3	<2	Moderate	0.28	5	6	2-5
	7-15	0.6-2.0	0.17-0.19	6.6-7.8	<2	Moderate	0.28			
	15-60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	0.28			
Roseglen	0-9	0.6-2.0	0.22-0.24	6.6-7.3	<2	Moderate	0.32	5	6	4-8
	9-33	0.6-2.0	0.20-0.22	6.6-7.8	<2	Moderate	0.32			
	33-60	0.6-6.0	0.11-0.17	6.6-7.8	<2	Low	0.32			
55A*:										
Parshall	0-19	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low	0.20	5	3	1-4
	19-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low	0.20			
Tally	0-8	2.0-6.0	0.12-0.16	6.1-7.8	<2	Low	0.20	5	3	1-3
	8-28	2.0-6.0	0.12-0.16	6.6-8.4	<2	Low	0.20			
	28-60	6.0-20	0.06-0.10	7.4-8.4	<2	Low	0.20			
55B Tally	0-8	2.0-6.0	0.12-0.16	6.1-7.8	<2	Low	0.20	5	3	1-3
	8-28	2.0-6.0	0.12-0.16	6.6-8.4	<2	Low	0.20			
	28-60	6.0-20	0.06-0.10	7.4-8.4	<2	Low	0.20			
56D Tansem Variant	0-7	0.6-2.0	0.18-0.20	6.6-7.8	<2	Low	0.28	5	6	1-3
	7-24	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low	0.28			
	24-60	0.6-2.0	0.12-0.20	7.4-8.4	<2	Low	0.28			
57A*, 57B*:										
Bryant	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.32	5	6	2-4
	7-15	0.6-2.0	0.19-0.22	6.6-7.8	<2	Low	0.43			
	15-60	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low	0.43			
Grassna	0-16	0.6-2.0	0.22-0.24	6.1-7.3	<2	Moderate	0.32	5	6	4-6
	16-60	0.6-2.0	0.16-0.22	6.6-8.4	<2	Moderate	0.32			
57C Bryant	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.32	5	6	2-4
	7-15	0.6-2.0	0.19-0.22	6.6-7.8	<2	Low	0.43			
	15-60	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low	0.43			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	In/hr	In/in	pH	Mmhos/cm					Pct
58B*:										
Temvik----------	0-8	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low---------	0.32	5	6	2-5
	8-31	0.6-2.0	0.20-0.22	6.6-7.8	<2	Low---------	0.43			
	31-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate----	0.43			
Grassna---------	0-16	0.6-2.0	0.22-0.24	6.1-7.3	<2	Moderate----	0.32	5	6	4-6
	16-60	0.6-2.0	0.16-0.22	6.6-8.4	<2	Moderate----	0.32			
Bearpaw---------	0-5	0.2-0.6	0.16-0.20	6.1-7.8	<2	Moderate----	0.28	5	6	2-5
	5-20	0.2-0.6	0.15-0.18	6.6-8.4	<2	High--------	0.37			
	20-42	0.2-0.6	0.15-0.18	7.4-8.4	2-4	High--------	0.37			
	42-60	0.06-0.2	0.15-0.18	7.4-9.0	2-8	High--------	0.37			
62--------------- Hamerly	0-13	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate----	0.28	5	4L	4-7
	13-34	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate----	0.28			
	34-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate----	0.37			
64--------------- Grassna	0-16	0.6-2.0	0.22-0.24	6.1-7.3	<2	Moderate----	0.32	5	6	4-6
	16-60	0.6-2.0	0.16-0.22	6.6-8.4	<2	Moderate----	0.32			
65--------------- Grail	0-6	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate----	0.32	5	7	4-6
	6-30	0.2-0.6	0.13-0.18	6.6-7.3	<2	High--------	0.32			
	30-60	0.2-0.6	0.14-0.22	7.4-8.4	<2	Moderate----	0.32			
72*:										
Ranslo----------	0-15	0.6-2.0	0.19-0.22	5.6-7.3	<2	Low---------	0.37	5	6	4-7
	15-28	0.06-0.2	0.13-0.16	6.6-8.4	2-4	High--------	0.28			
	28-33	0.06-0.2	0.08-0.13	7.4-8.4	2-8	High--------	0.28			
	33-60	0.2-0.6	0.14-0.17	7.4-9.0	2-8	High--------	0.28			
Harriet---------	0-2	0.06-0.2	0.20-0.24	6.6-8.4	<2	Moderate----	0.37	3	6	3-6
	2-15	<0.06	0.10-0.15	>7.3	4-16	High--------	0.37			
	15-46	0.06-0.2	0.10-0.15	>7.8	4-16	Moderate----	0.37			
	46-60	2.0-6.0	0.10-0.15	>7.8	4-16	Low---------	0.28			
75*:										
Tonka-----------	0-12	0.6-2.0	0.18-0.23	5.6-7.3	<2	Low---------	0.32	5	6	5-10
	12-42	0.06-0.2	0.14-0.19	5.6-7.8	<2	High--------	0.43			
	42-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate----	0.43			
Nishon----------	0-7	0.6-2.0	0.18-0.22	6.1-7.8	<2	Low---------	0.43	5	6	3-6
	7-19	0.06-0.2	0.14-0.18	6.6-9.0	<2	High--------	0.32			
	19-60	0.06-0.2	0.14-0.18	7.4-9.0	2-4	High--------	0.32			
76--------------- Parnell	0-7	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate----	0.28	5	7	6-10
	7-45	0.06-0.2	0.13-0.19	6.6-7.8	<2	High--------	0.28			
	45-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High--------	0.28			
77*:										
Nishon----------	0-7	0.6-2.0	0.18-0.22	6.1-7.8	<2	Low---------	0.43	5	6	3-6
	7-19	0.06-0.2	0.14-0.18	6.6-9.0	<2	High--------	0.32			
	19-60	0.06-0.2	0.14-0.18	7.4-9.0	2-4	High--------	0.32			
Heil------------	0-2	<0.06	0.15-0.24	5.6-7.3	<2	Moderate----	0.28	3	7	3-6
	2-26	<0.06	0.13-0.18	6.6-9.0	4-16	High--------	0.28			
	26-60	<0.06	0.13-0.18	7.9-9.0	4-16	High--------	0.28			
80--------------- Heil	0-2	<0.06	0.15-0.24	5.6-7.3	<2	Moderate----	0.28	3	7	3-6
	2-26	<0.06	0.13-0.18	6.6-9.0	4-16	High--------	0.28			
	26-60	<0.06	0.13-0.18	7.9-9.0	4-16	High--------	0.28			
82--------------- Stirum	0-6	0.6-2.0	0.18-0.20	5.1-6.5	<2	Low---------	0.24	3	6	3-6
	6-8	2.0-6.0	0.10-0.17	5.1-6.5	<2	Low---------	0.24			
	8-19	0.2-0.6	0.12-0.18	5.6-7.3	2-8	Low---------	0.32			
	19-41	6.0-20	0.08-0.10	6.6-8.4	2-8	Low---------	0.15			
	41-60	0.2-0.6	0.11-0.17	6.6-8.4	2-8	Moderate----	0.32			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	In/hr	In/in	pH	Mmhos/cm					Pct
85---------------- Ranslo	0-15	0.6-2.0	0.19-0.22	5.6-7.3	<2	Low----------	0.37	5	6	4-7
	15-28	0.06-0.2	0.13-0.16	6.6-8.4	2-4	High---------	0.28			
	28-33	0.06-0.2	0.08-0.13	7.4-8.4	2-8	High---------	0.28			
	33-60	0.2-0.6	0.14-0.17	7.4-9.0	2-8	High---------	0.28			
86---------------- Harriet	0-2	0.06-0.2	0.20-0.24	6.6-8.4	<2	Moderate-----	0.37	3	6	3-6
	2-15	<0.06	0.10-0.15	>7.3	4-16	High---------	0.37			
	15-46	0.06-0.2	0.10-0.15	>7.8	4-16	Moderate-----	0.37			
	46-60	2.0-6.0	0.10-0.15	>7.8	4-16	Low----------	0.28			
87---------------- Marysland	0-11	0.6-2.0	0.17-0.22	7.9-8.4	<2	Moderate-----	0.28	4	4L	5-8
	11-27	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate-----	0.28			
	27-60	>6.0	0.02-0.07	7.9-8.4	<2	Low----------	0.15			
88---------------- Divide	0-8	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low----------	0.28	4	4L	2-8
	8-30	0.6-2.0	0.16-0.19	7.9-8.4	<2	Low----------	0.28			
	30-60	>6.0	0.03-0.07	7.9-8.4	<2	Low----------	0.10			
97---------------- Regan	0-15	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate-----	0.32	5	4L	2-8
	15-60	0.2-2.0	0.14-0.17	7.9-9.0	<8	Moderate-----	0.32			
98---------------- Vallers	0-13	0.2-0.6	0.18-0.22	7.4-8.4	<4	Moderate-----	0.28	5	4L	5-8
	13-36	0.2-0.6	0.15-0.19	7.9-8.4	<4	Moderate-----	0.28			
	36-60	0.2-0.6	0.17-0.19	7.4-8.4	<4	Low----------	0.28			
99*. Pits										
100--------------- Parnell	0-7	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate-----	0.28	5	8	6-10
	7-45	0.06-0.2	0.13-0.19	6.6-7.8	<2	High---------	0.28			
	45-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High---------	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
3A, 3B: Bowdle	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
5A: Bowbells	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	High	High	Low.
5B: Bowbells	B	None	---	---	>6.0	---	---	Moderate	High	Low.
6: Arnegard	B	None	---	---	>6.0	---	---	Moderate	High	Low.
7: Bearden	C	None	---	---	1.5-2.5	Apparent	Sep-Jun	High	High	Low.
8: Rentill	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.
9A, 9B, 9C: Bearpaw	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
10: Brantford	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
11A*, 11B*:										
Bearpaw	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Greenway	B	None	---	---	>6.0	---	---	Moderate	High	Low.
13E*:										
Zahl	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
Kloten	D	None	---	---	>6.0	---	---	Moderate	High	Low.
14D: Vida	B	None	---	---	>6.0	---	---	Moderate	High	Low.
15A*, 15B*, 15C*:										
Williams	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Bowbells	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	High	High	Low.
16A*, 16B*:										
Williams	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Bowbells	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	High	High	Low.
Tonka	C/D	None	---	---	+.5-1.0	Apparent	Apr-Jun	High	High	Low.
16C*:										
Williams	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Bowbells	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	High	High	Low.
Parnell	C/D	None	---	---	+2-2.0	Apparent	Jan-Dec	High	High	Low.
17B*:										
Vida	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Williams	B	None	---	---	>6.0	---	---	Moderate	High	Low.
17C*:										
Vida	B	None	---	---	>6.0	---	---	Moderate	High	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft					
17C*:										
Williams	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Bowbells	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	High	High	Low.
17D*:										
Vida	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Zahl	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
17E*:										
Vida	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Zahill	B	None	---	---	>6.0	---	---	Moderate	High	Low.
18A*:										
Williams	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Niobell	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
20A, 20B Lehr	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
21A*:										
Cavour	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Miranda	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
22A*:										
Niobell	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Miranda	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
23A Noonan Variant	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
24A*:										
Niobell	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Noonan	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
25*:										
Miranda	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Heil	D	None	---	---	+1-1.0	Apparent	Mar-Sep	Moderate	High	Moderate.
26*:										
Cresbard	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Cavour	D	None	---	---	>6.0	---	---	Moderate	High	Moderate.
27B*:										
Lehr	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
Bowdle	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
29*:										
Exline	D	None	---	---	2.5-4.0	Apparent	Apr-Jun	Moderate	High	High.
Harmony	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
30*:										
Letcher	D	None	---	---	3.5-6.0	Perched	Mar-Jul	Moderate	High	Moderate.
Parshall	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
31 Harmony	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft					
32*:										
Harmony	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Exline	D	None	---	---	2.5-4.0	Apparent	Apr-Jun	Moderate	High	High.
37 Straw	B	Frequent	Brief	Mar-May	3.0-6.0	Apparent	Apr-Jun	Moderate	High	Moderate.
38 Regan	B/D	Occasional	Brief to long.	Mar-Jun	0-1.0	Apparent	Oct-Jun	High	High	Low.
40A, 40B Mondamin	C	None	---	---	5.0-6.0	Perched	Oct-Jun	Low	High	Low.
43C*:										
Wabek	A	None	---	---	>6.0	---	---	Low	Moderate	Low.
Bowdle	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
44D Wabek	A	None	---	---	>6.0	---	---	Low	Moderate	Low.
45B*:										
Wabek	A	None	---	---	>6.0	---	---	Low	Moderate	Low.
Lehr	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
52B*:										
Lihen	A	None	---	---	>6.0	---	---	Low	High	Low.
Parshall	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
52D Lihen	A	None	---	---	>6.0	---	---	Low	High	Low.
54B*:										
Tansem	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
Roseglen	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
55A*:										
Parshall	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
Tally	B	None	---	---	>6.0	---	---	Moderate	High	Low.
55B Tally	B	None	---	---	>6.0	---	---	Moderate	High	Low.
56D Tansem Variant	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
57A*, 57B*:										
Bryant	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Grassna	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	Moderate	High	Low.
57C Bryant	B	None	---	---	>6.0	---	---	Moderate	High	Low.
58B*:										
Temvik	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Grassna	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	Moderate	High	Low.
Bearpaw	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
62 Hamerly	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	High	High	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
64----------------- Grassna	B	Occasional	Very brief	Mar-Nov	4.0-6.0	Perched	Apr-Jun	Moderate	High-----	Low.
65----------------- Grail	C	Frequent----	Very brief	Mar-Oct	3.0-6.0	Perched	Mar-Oct	Moderate	High-----	Low.
72*:										
Ranslo-----------	D	Occasional	Very brief	Apr-Jun	1.0-3.0	Apparent	Apr-Jun	High-----	High-----	Moderate.
Harriet----------	D	Occasional	Long------	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Moderate.
75*:										
Tonka------------	C/D	None--------	---	---	+.5-1.0	Apparent	Apr-Jun	High-----	High-----	Low.
Nishon-----------	D	None--------	---	---	+.5-1.0	Perched	Apr-Aug	Moderate	High-----	Low.
76----------------- Parnell	C/D	None--------	---	---	+2-2.0	Apparent	Jan-Dec	High-----	High-----	Low.
77*:										
Nishon-----------	D	None--------	---	---	+.5-1.0	Perched	Apr-Aug	Moderate	High-----	Low.
Heil-------------	D	None--------	---	---	+1-1.0	Apparent	Mar-Sep	Moderate	High-----	Moderate.
80----------------- Heil	D	None--------	---	---	+1-1.0	Apparent	Mar-Sep	Moderate	High-----	Moderate.
82----------------- Stirum	D	None--------	---	---	+.5-1.0	Apparent	Apr-Jun	Moderate	High-----	Moderate.
85----------------- Ranslo	D	Occasional	Very brief	Apr-Jun	1.0-3.0	Apparent	Apr-Jun	High-----	High-----	Moderate.
86----------------- Harriet	D	Occasional	Long------	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Moderate.
87----------------- Marysland	B/D	Rare--------	---	---	1.0-2.5	Apparent	Nov-Jul	High-----	High-----	Low.
88----------------- Divide	B	None--------	---	---	2.5-5.0	Apparent	Apr-Jun	Moderate	High-----	Low.
97----------------- Regan	B/D	Frequent----	Brief to long.	Mar-Jun	0-1.0	Apparent	Oct-Jun	High-----	High-----	Low.
98----------------- Vallers	C	None to rare	---	---	1.0-2.5	Apparent	Nov-Jun	High-----	High-----	Low.
99*. Pits										
100---------------- Parnell	C/D	None--------	---	---	+2-2.0	Apparent	Jan-Dec	High-----	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING TEST DATA

[Dashes indicate data were not available]

Soil name, report number, horizon, and depth in inches	Classification: AASHTO	Classification: Unified	Grain-size distribution: >3	Percentage passing sieve--: 3/8 inch	No. 4	No. 10	No. 40	No. 200	Percentage smaller than--: .02 mm	.005 mm	.002 mm	Liquid limit	Plasticity index	Moisture density: Max. dry density	Optimum moisture
			Pct									Pct		Lb/ft3	Pct
Bearpaw loam: (S76SD-089-037)															
B2t------ 5 to 14	A-7-6(21)	CH	0	100	100	99	94	76	--	44	--	55	26	91	26
B3ca-----14 to 24	A-7-6(26)	CH	0	100	100	99	94	82	--	50	--	55	29	92	26
C1ca-----24 to 60	A-7-6(28)	CH	0	100	99	98	93	81	--	46	--	59	32	93	25
Bowbells loam: (S75SD-089-033)															
Ap------- 0 to 8	A-7-6(11)	ML	0	100	100	99	96	77	--	35	--	41	14	86	30
B21t----- 8 to 27	A-6(10)	CL	0	100	100	98	92	66	--	36	--	40	18	106	19
C1ca-----27 to 60	A-6(11)	CL	0	100	98	96	91	69	--	34	--	37	18	108	18
Brantford loam: (S77SD-089-060)															
Ap------- 0 to 7	A-6(07)	ML	0	100	100	99	87	66	--	24	--	38	13	96	24
B21------ 7 to 16	A-7-6(06)	CL	0	100	98	95	78	51	--	28	--	42	18	104	20
IIC1-----16 to 60	A-7-5(04)	SM	0	100	92	88	64	41	--	22	--	56	20	93	25
Harriet loam: (S75SD-089-029)															
B2t------ 2 to 15	A-7-6(19)	CL	0	100	100	100	95	72	--	45	--	48	28	100	22
C1ca-----15 to 46	A-7-6(23)	CL	0	100	100	100	96	79	--	39	--	46	30	108	18
Letcher loam: (S76SD-089-015)															
A11------ 0 to 15	A-4(01)	ML	0	100	100	100	92	51	--	18	--	32	7	93	25
B2t------19 to 25	A-2-4(00)	SC	0	100	100	100	88	32	--	18	--	25	9	117	14
C1ca-----33 to 37	A-6(05)	SC	0	100	100	100	93	48	--	22	--	35	19	113	15
IIC1-----41 to 60	A-7-6(14)	CL	0	100	99	98	90	60	--	31	--	45	28	112	16
Niobell loam: (S74SD-089-022)															
B21t-----13 to 26	A-6(05)	CL	0	100	100	100	96	58	--	31	--	32	12	111	16
C1-------31 to 60	A-6(09)	CL	0	100	100	98	93	70	--	37	--	33	16	112	16
Noonan loam: (S74SD-089-023)															
B21t----- 9 to 19	A-6(08)	CL	0	100	100	100	92	63	--	33	--	37	15	107	18
C1cs-----28 to 60	A-6(09)	CL	0	100	97	95	88	66	--	34	--	37	16	110	17
Tally fine sandy loam: (S77SD-089-017)															
A1------- 0 to 8	A-4(00)	SM-SC	0	100	100	100	89	36	--	14	--	28	6	104	20
B2------- 8 to 15	A-2-4(00)	SM-SC	0	100	100	100	92	25	--	16	--	22	6	117	14
C1ca-----25 to 60	A-2-4(00)	SM	0	100	100	100	81	17	--	10	--	18	2	118	13

TABLE 16.--ENGINEERING TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasticity index	Moisture density	
			>3	Percentage passing sieve--					Percentage smaller than--						
	AASHTO	Unified		3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Max. dry density	Optimum moisture
			Pct									Pct		Lb/ft3	Pct
Zahill loam: (S75SD-089-015)															
C1ca------ 3 to 43	A-6(09)	CL	3	100	96	95	86	66	--	35	--	40	16	96	24
Zahl loam: (S76SD-089-018)															
A11------- 0 to 6	A-7-6(06)	ML	2	100	98	96	87	54	--	24	--	42	15	92	26
C1ca------ 6 to 60	A-6(09)	CL	2	100	94	92	85	63	--	32	--	38	17	104	20

TABLE 17.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
*Arnegard	Fine-loamy, mixed Pachic Haploborolls
*Bearden	Fine-silty, frigid Aeric Calciaquolls
Bearpaw	Fine, montmorillonitic Typic Argiborolls
*Bowbells	Fine-loamy, mixed Pachic Argiborolls
Bowdle	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Haploborolls
Brantford	Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls
Bryant	Fine-silty, mixed Typic Haploborolls
Cavour	Fine, montmorillonitic Udic Natriborolls
Cresbard	Fine, montmorillonitic Glossic Udic Natriborolls
Divide	Fine-loamy over sandy or sandy-skeletal, frigid Aeric Calciaquolls
*Exline	Fine, montmorillonitic Leptic Natriborolls
*Grail	Fine, montmorillonitic Pachic Argiborolls
*Grassna	Fine-silty, mixed Pachic Haploborolls
Greenway	Fine-loamy, mixed Typic Argiborolls
Hamerly	Fine-loamy, frigid Aeric Calciaquolls
Harmony	Fine, montmorillonitic Pachic Udic Argiborolls
Harriet	Fine, mixed, frigid Typic Natraquolls
Heil	Fine, montmorillonitic, frigid Typic Natraquolls
Kloten	Loamy, mixed Lithic Haploborolls
Lehr	Fine-loamy over sandy or sandy-skeletal, mixed Typic Haploborolls
Letcher	Coarse-loamy, mixed Udic Natriborolls
Lihen	Sandy, mixed Entic Haploborolls
Marysland	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
Miranda	Fine-loamy, mixed Leptic Natriborolls
*Mondamin	Fine, montmorillonitic Typic Argiborolls
Niobell	Fine-loamy, mixed Glossic Natriborolls
Nishon	Fine, montmorillonitic, frigid Typic Albaqualfs
Noonan	Fine-loamy, mixed Typic Natriborolls
Noonan Variant	Fine-loamy over sandy or sandy-skeletal, mixed Typic Natriborolls
Parnell	Fine, montmorillonitic, frigid Typic Argiaquolls
*Parshall	Coarse-loamy, mixed Pachic Haploborolls
Ranslo	Fine, montmorillonitic, frigid Typic Natraquolls
Regan	Fine-silty, frigid Typic Calciaquolls
*Rentill	Coarse-loamy over clayey, mixed Udic Haploborolls
*Roseglen	Fine-loamy, mixed Pachic Haploborolls
*Stirum	Coarse-loamy, mixed, frigid Typic Natraquolls
*Straw	Fine-loamy, mixed Cumulic Haploborolls
Tally	Coarse-loamy, mixed Typic Haploborolls
Tansem	Fine-loamy, mixed Typic Haploborolls
Tansem Variant	Fine-loamy, mixed Entic Haploborolls
Temvik	Fine-silty, mixed Typic Haploborolls
Tonka	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Vallers	Fine-loamy, frigid Typic Calciaquolls
Vida	Fine-loamy, mixed Typic Argiborolls
Wabek	Sandy-skeletal, mixed Entic Haploborolls
Williams	Fine-loamy, mixed Typic Argiborolls
Zahill	Fine-loamy, mixed (calcareous), frigid Typic Ustorthents
Zahl	Fine-loamy, mixed Entic Haploborolls

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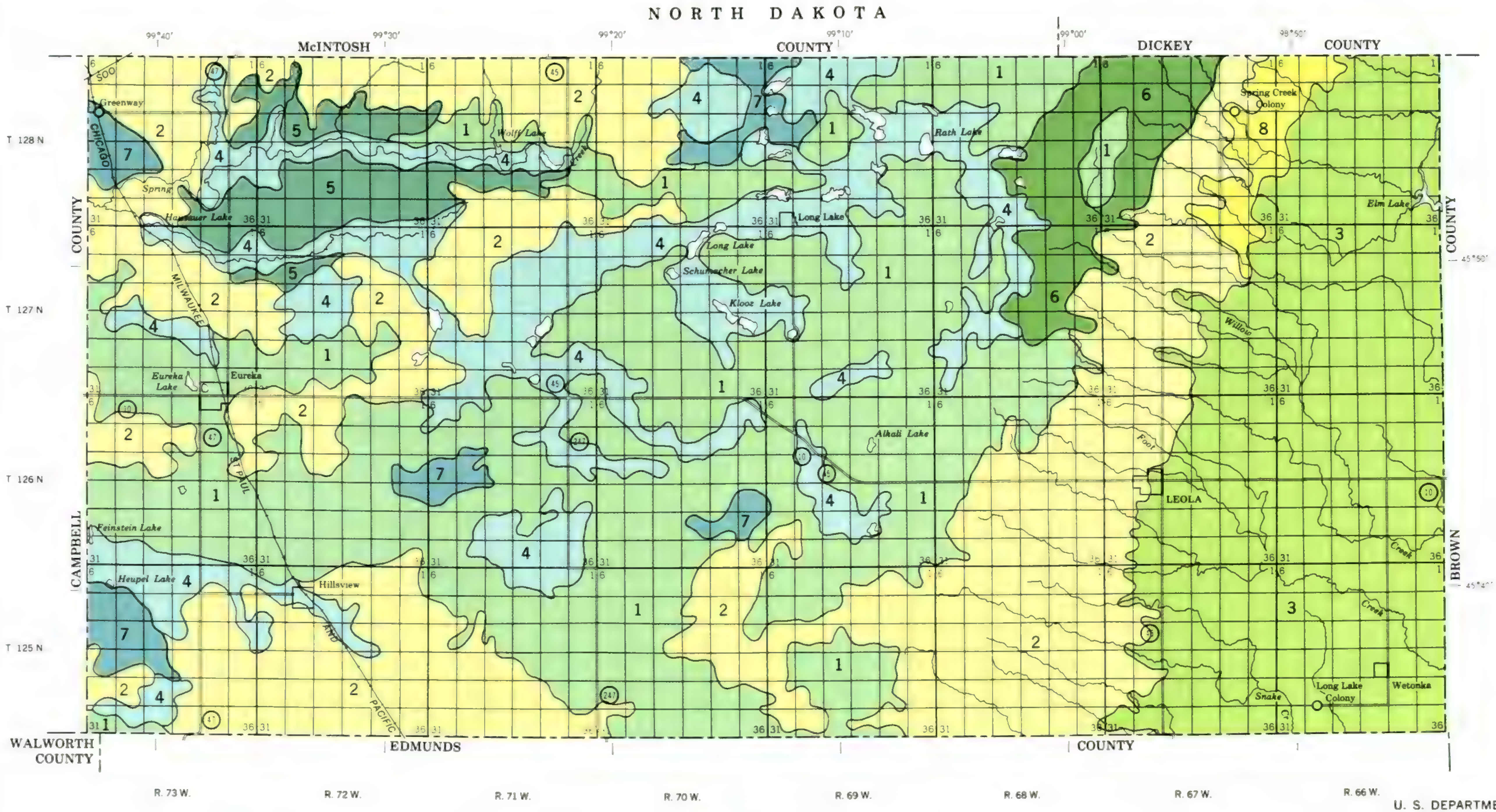


SOIL LEGEND*

1	Williams-Vida association: Well drained, undulating to hilly, loamy soils on uplands
2	Williams-Bowbells association: Well drained and moderately well drained, nearly level to gently rolling, loamy soils on uplands and in swales on uplands
3	Niobell-Noonan-Miranda association: Moderately well drained and somewhat poorly drained, nearly level and gently sloping, sodium affected, loamy soils on uplands
4	Lehr-Bowdle-Wabek association: Excessively drained to well drained, nearly level to hilly, loamy soils on outwash plains, terraces, and uplands
5	Bearpaw-Greenway association: Well drained, nearly level to moderately sloping, loamy soils on uplands
6	Vida association: Well drained, undulating to moderately steep, loamy soils on uplands
7	Bryant-Grassna association: Well drained and moderately well drained, nearly level to moderately sloping, silty soils on uplands and in swales on uplands
8	Harmony-Arnegard association: Moderately well drained and well drained, nearly level, silty and loamy soils on lake plains

*The texture terms in the descriptive headings refer to the surface layer of the major soils in each association

Compiled 1980

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

McPHERSON COUNTY, SOUTH DAKOTA

Scale 1:253,440

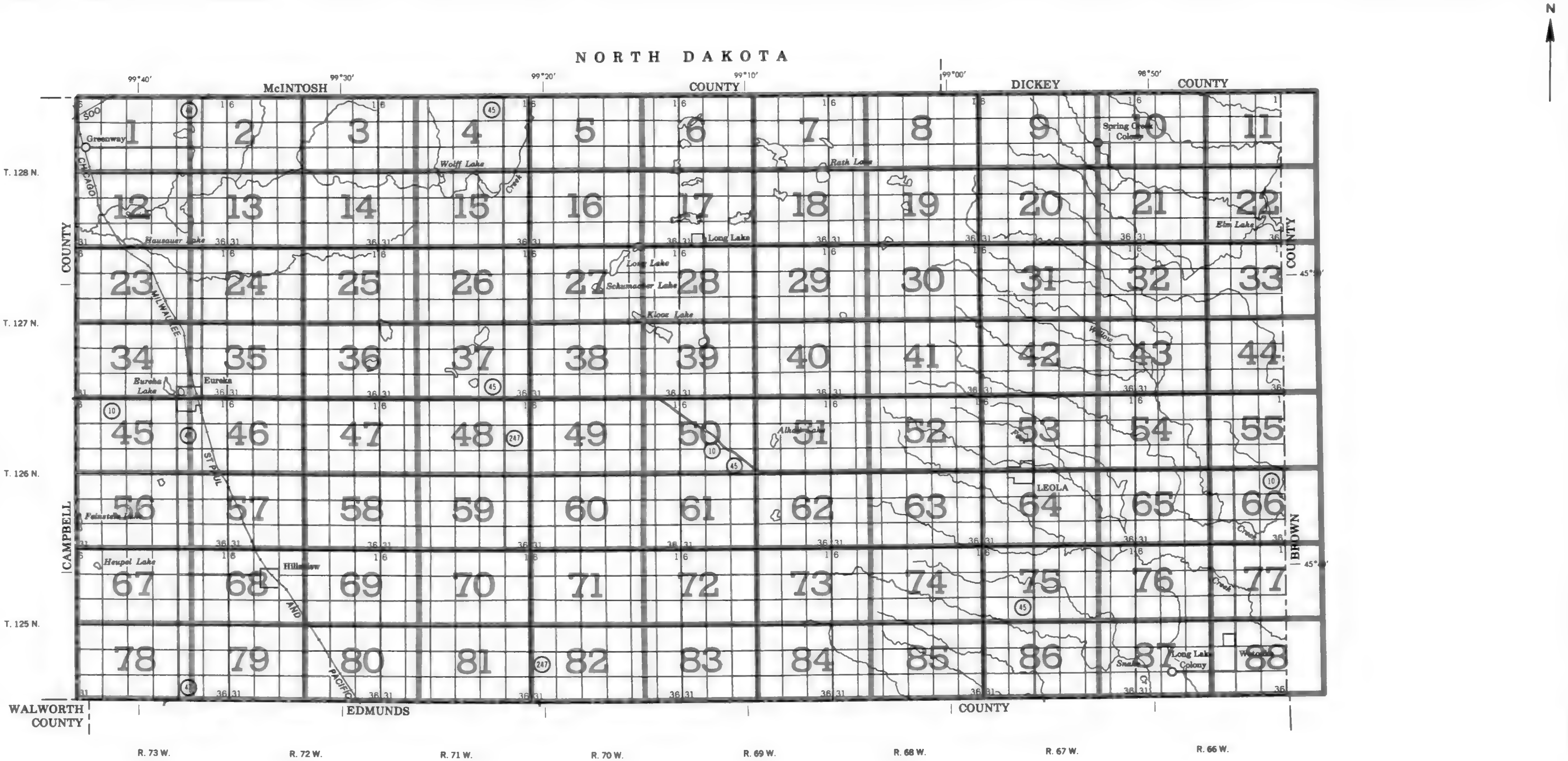
1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



Original text from each individual map sheet read:
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS
McPHERSON COUNTY, SOUTH DAKOTA

Scale 1: 253,440

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and letters. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME	SYMBOL	NAME
3A	Bowdle loam 0 to 3 percent slopes	30	Letcher-Parshall loams, 0 to 4 percent slopes
3B	Bowdle loam 3 to 6 percent slopes	31	Harmony silty clay loam
5A	Bowbells loam 0 to 2 percent slopes	32	Harmony-Exline complex
5B	Bowbells loam, 2 to 6 percent slopes	37	Straw loam channeled
6	Arnegard loam	38	Regan silt loam
7	Bearden silt loam	40A	Mondamin silty clay loam, 0 to 3 percent slopes
8	Rentill loam	40B	Mondamin silty clay loam, 3 to 6 percent slopes
9A	Bearpaw loam, 0 to 3 percent slopes	43C	Wabek-Bowdle complex, 3 to 15 percent slopes
9B	Bearpaw loam, 3 to 6 percent slopes	44D	Wabek gravelly loam, 6 to 20 percent slopes
9C	Bearpaw loam, 6 to 9 percent slopes	45B	Wabek-Lehr complex, 2 to 9 percent slopes
10	[illegible]	52B	Lihen-Parshall fine sandy loams, 0 to 6 percent slopes
11A	Bearpaw-Greenway loams, 0 to 3 percent slopes	52D	Lihen loamy fine sand, 6 to 20 percent slopes
11B	Bearpaw-Greenway loams, 3 to 6 percent slopes	54B	Tansem-Rosegien loams, 2 to 6 percent slopes
13E	Zahl-Kloten loams, 9 to 35 percent slopes	55A	Parshall-Tally fine sandy loams, 0 to 3 percent slopes
14D	Vida extremely stony loam, 3 to 15 percent slopes	55B	Tally fine sandy loam, 2 to 6 percent slopes
15A	Williams-Bowbells loams, 0 to 3 percent slopes	56D	Tansem Variant loam, 9 to 15 percent slopes
15B	Williams-Bowbells loams, 1 to 6 percent slopes	57A	Bryant-Grassna silt loams, 0 to 3 percent slopes
15C	Williams-Bowbells loams, 2 to 9 percent slopes	57B	Bryant-Grassna silt loams, 1 to 6 percent slopes
16A	Williams-Bowbells-Tonka complex 0 to 3 percent slopes	57C	Bryant silt loam, 6 to 9 percent slopes
16B	Williams-Bowbells-Tonka complex, 1 to 6 percent slopes	58B	Temvik-Grassna-Bearpaw complex, 1 to 6 percent slopes
16C	Williams-Bowbells-Parnell complex, 1 to 9 percent slopes	62	Hamerly loam
17B	Vida-Williams loams, 3 to 6 percent slopes	64	Grassna silt loam
17C	Vida-Williams-Bowbells loams, 2 to 15 percent slopes	65	Grail silty clay loam
17D	Vida-Zahl loams, 6 to 15 percent slopes	72	Ransio-Harriet loams
17E	Vida-Zahill loams, 15 to 25 percent slopes	75	Tonka-Nishon silt loams
18A	Williams-Niobell loams, 0 to 3 percent slopes	76	Parnell silty clay loam
20A	Lehr loam, 0 to 3 percent slopes	77	Nishon-Heil silt loams
20B	Lehr loam, 3 to 6 percent slopes	80	Heil silt loam
21A	Cavour-Miranda loams, 1 to 5 percent slopes	82	Stirum loam
22A	Niobell-Miranda loams, 0 to 3 percent slopes	85	Ransio loam
23A	Noonan Variant loam, 0 to 2 percent slopes	86	Harriet loam
24A	Niobell-Noonan loams, 1 to 5 percent slopes	87	Marysland loam
25	Miranda-Heil complex	88	[illegible]
26	Cresbard Cavour loams	97	Regan silt loam wet
27B	Lehr-Bowdle loams 0 to 6 percent slopes	98	Vallers silty clay loam
29	Exline-Harmony complex	99	Pits, gravel
		100	Parnell silty clay loam ponded

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state or province

County or parish

Field sheet matchline & neatline

AD HOC BOUNDARY (label)

Small airport, airfield, park, oilfield, cemetery, or flood pool

Dove Airstrip

FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

ROAD EMBLEMS & DESIGNATIONS

Federal

416

State

52

RAILROAD

DAMS

Medium or small

water

w

PITS

Gravel pit

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban areas)

Church

School

WATER FEATURES

DRAINAGE

Perennial, double line

Perennial, single line

Intermittent

Drainage end

MISCELLANEOUS WATER FEATURES

Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS 77 15A

MISCELLANEOUS

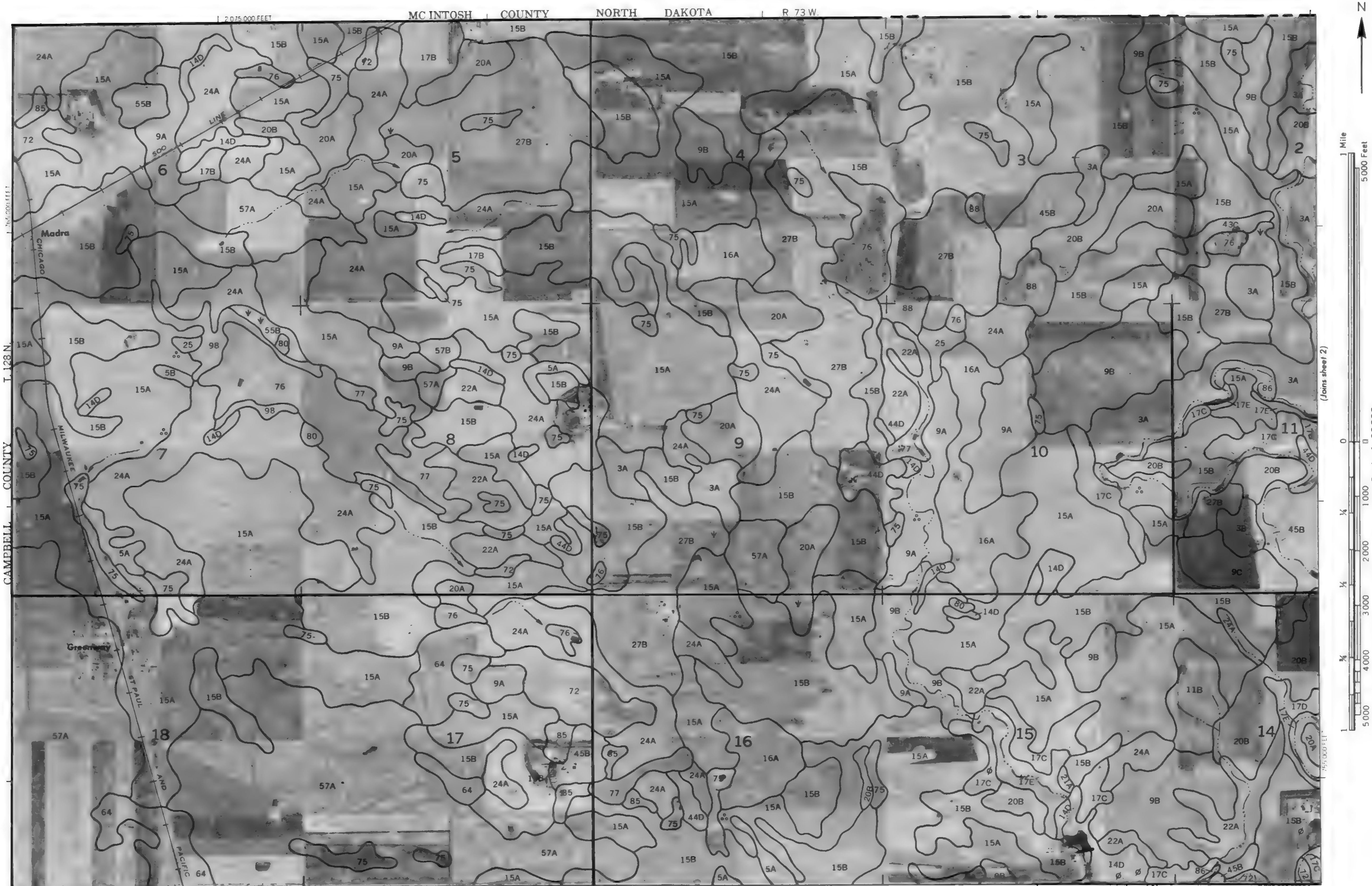
Gravelly spot

Gumbo

Saline spot

McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 1

1



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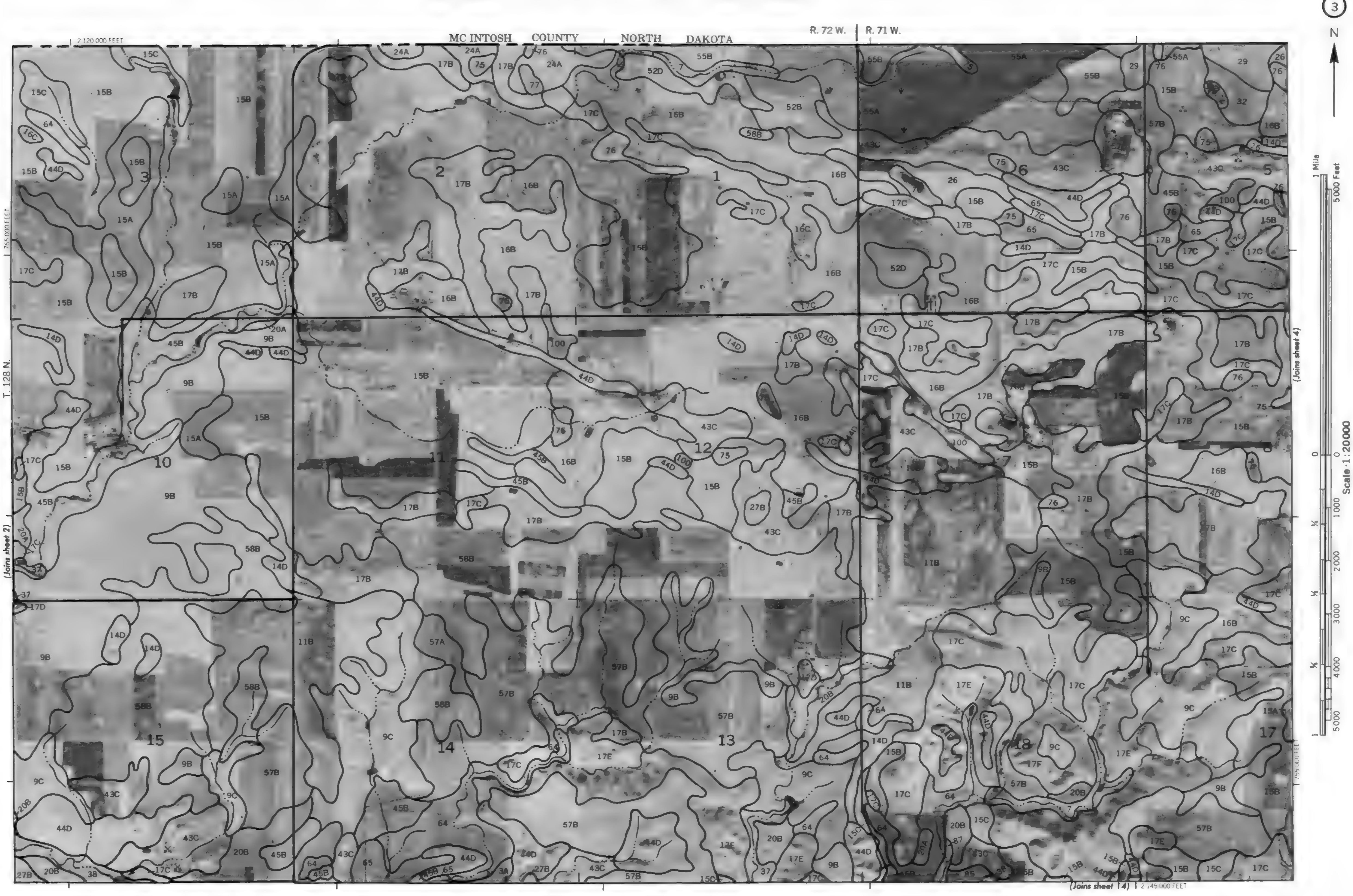
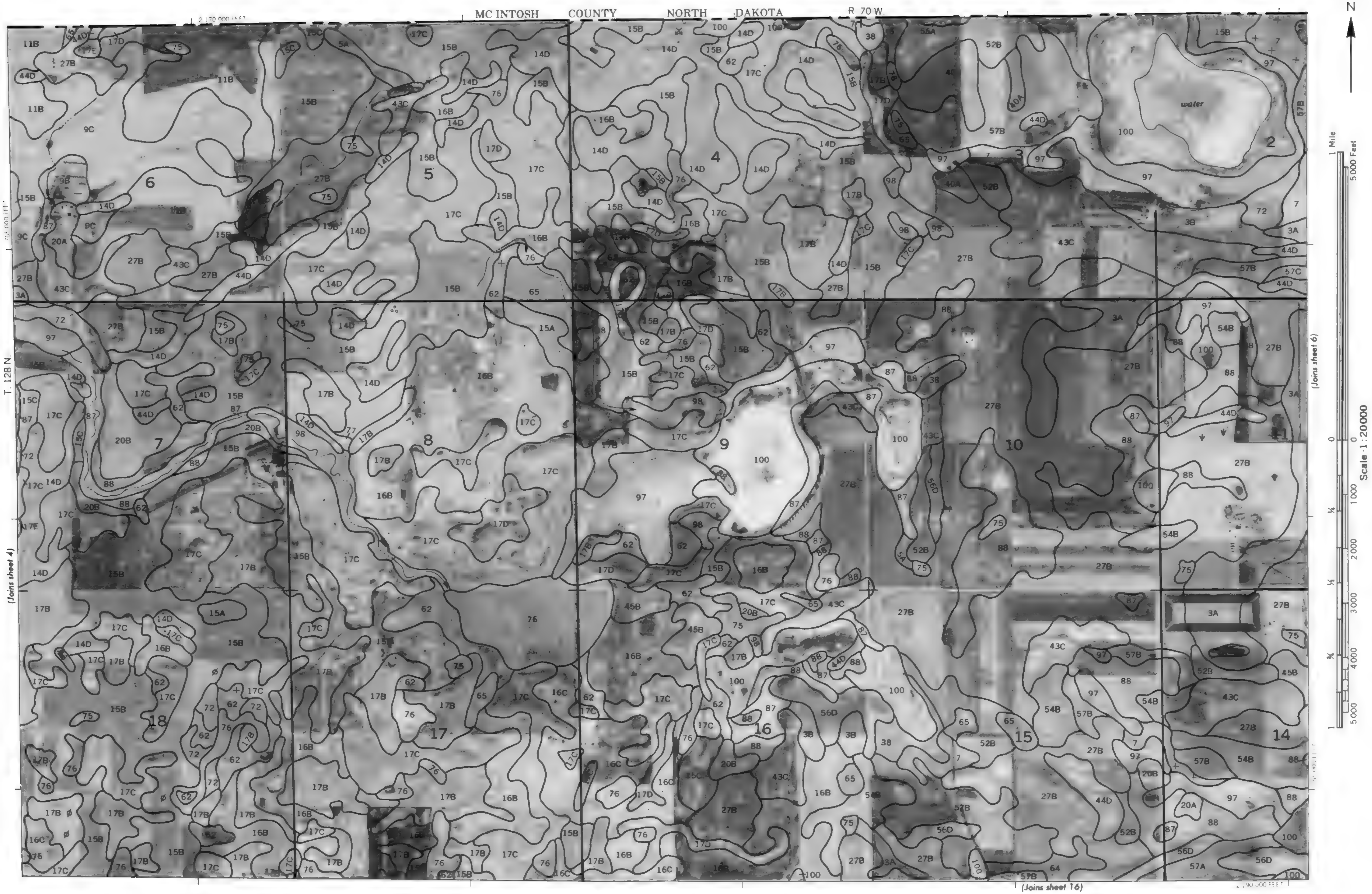
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 2

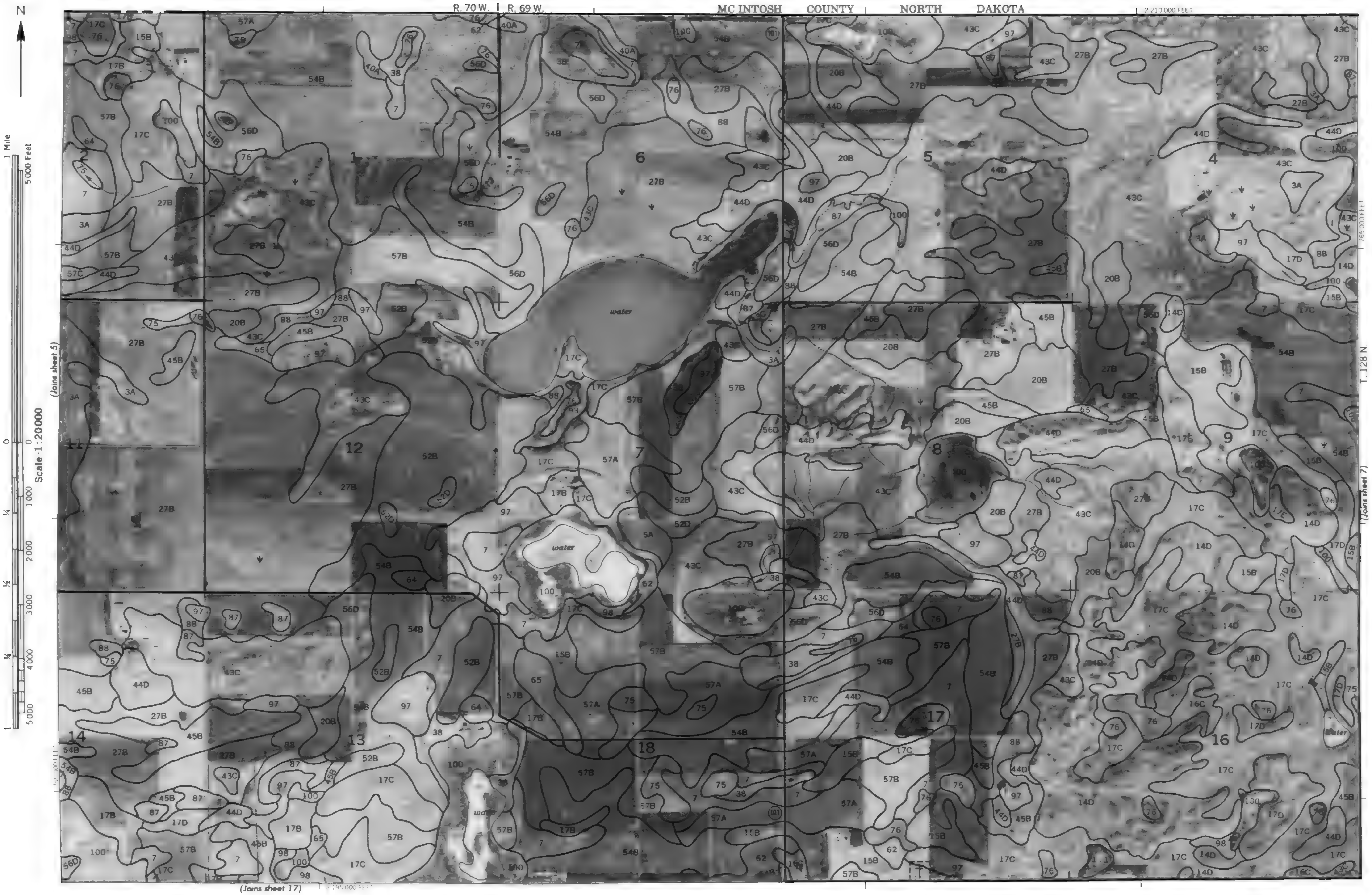
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 3




N
R. 71 W.
MC INTOSH COUNTY NORTH DAKOTA
T. 128 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 15)
2 145 000 FEET
2 165 000 FEET
755 000 FEET
1 Mile
5000 Feet
Scale 1:20000
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

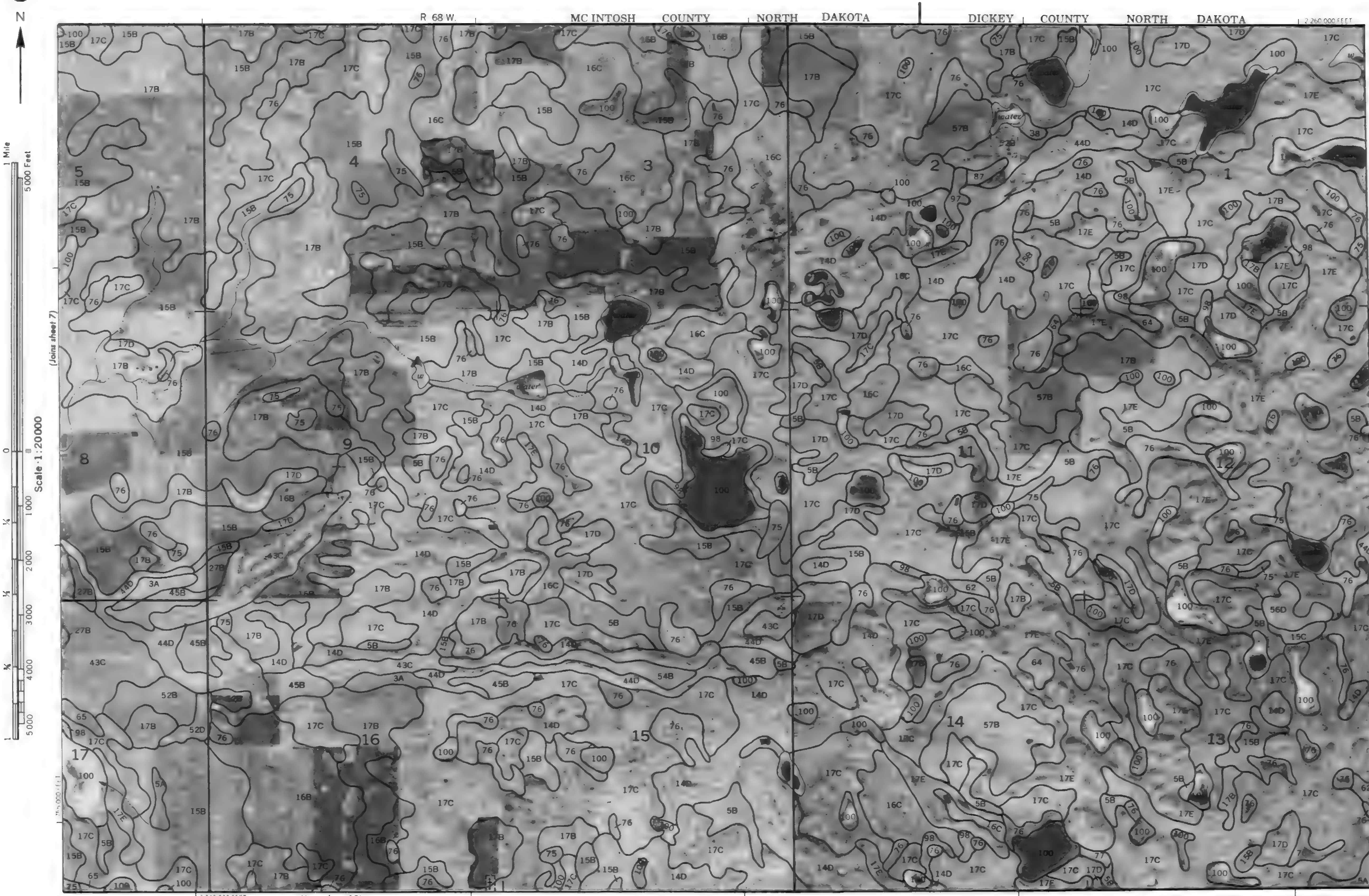
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 5



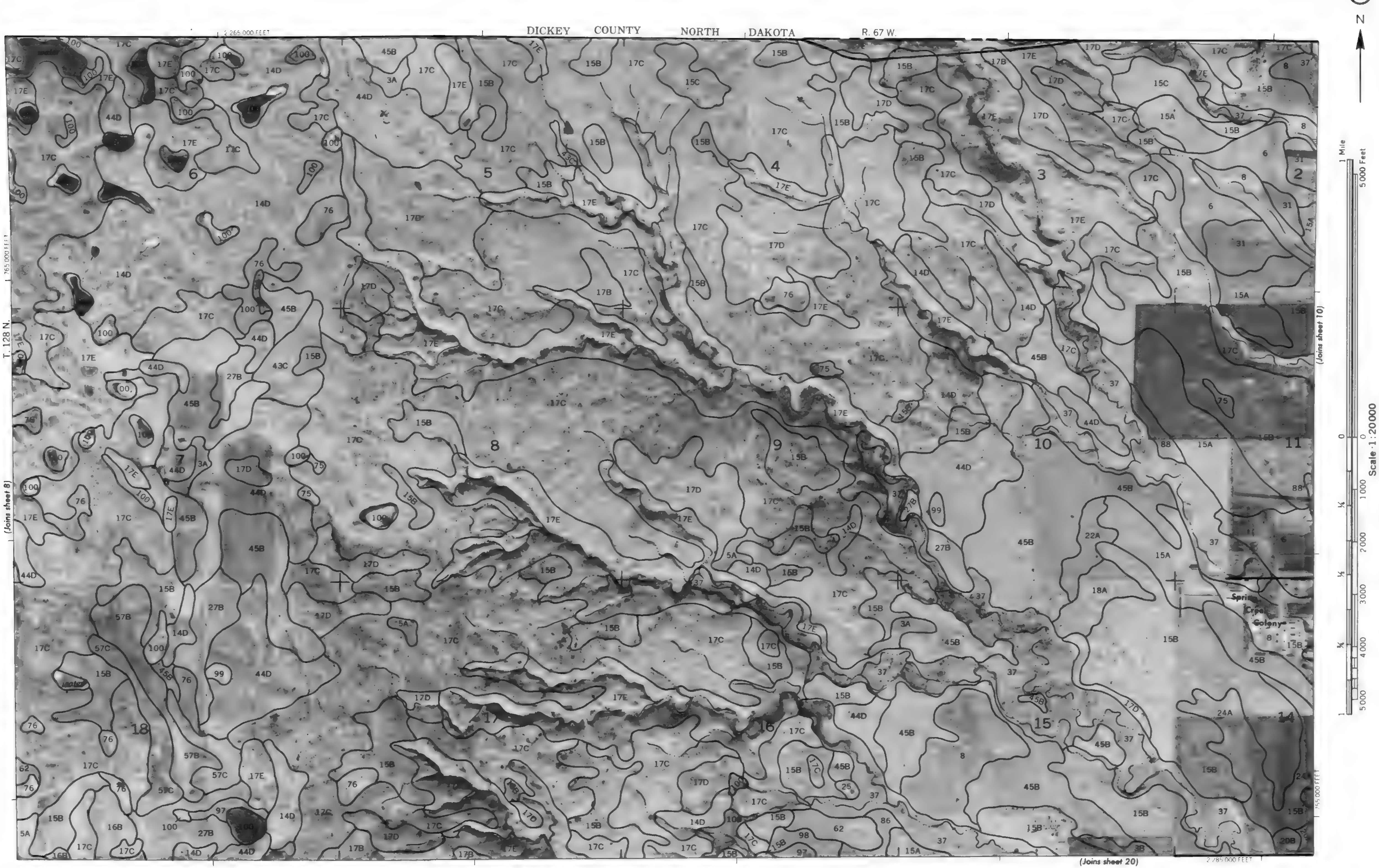

N
R. 70 W.
R. 69 W.
MC INTOSH COUNTY NORTH DAKOTA
2 210 000 FEET
T. 128 N.
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 17)
Scale 1:20000
1 Mile
5000 Feet
water

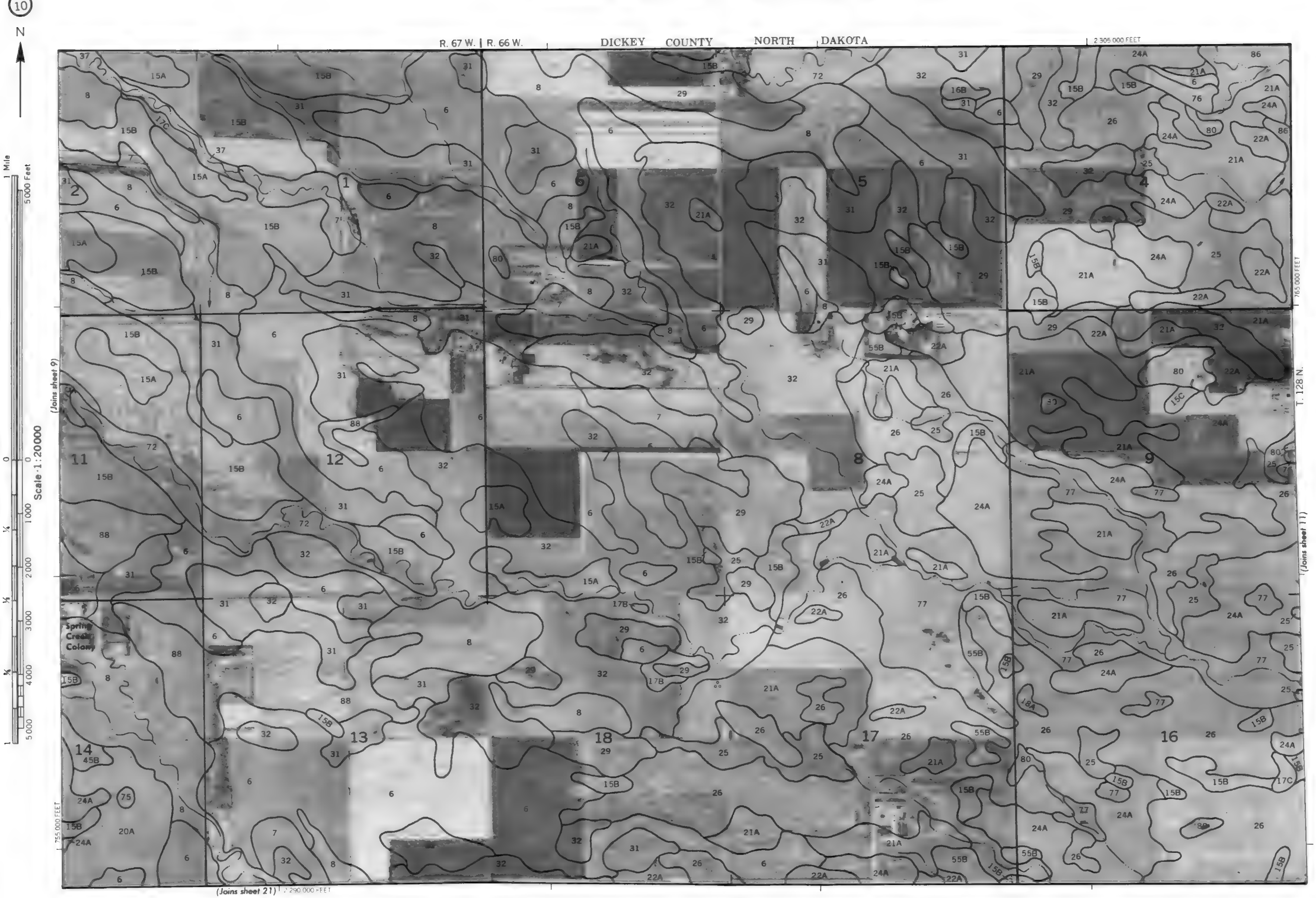
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 7

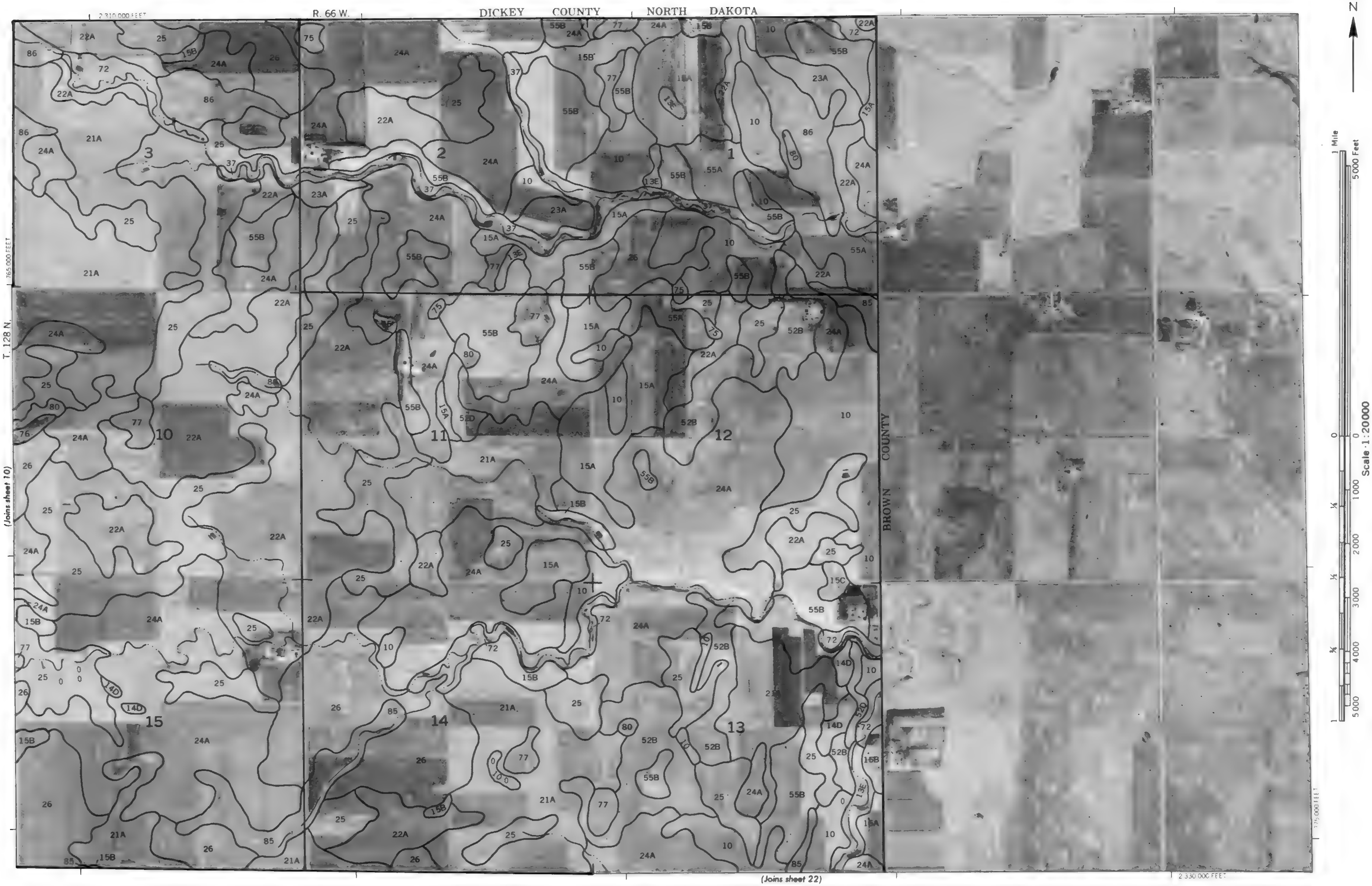
8



N
R. 68 W.
MC INTOSH COUNTY NORTH DAKOTA
DICKEY COUNTY NORTH DAKOTA
T. 128 N.
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 19)
Scale 1:20000
1 Mile
5000 Feet
2 240 000 FEET
2 260 000 FEET


N
DICKEY COUNTY NORTH DAKOTA
R. 67 W.
2 265 000 FEET
T. 128 N.
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 20)
2 285 000 FEET
Spring Creek Colony
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
Scale 1:20000


10
N
1 Mile
5000 Feet
Scale 1:20000
R. 67 W. | R. 66 W.
DICKEY COUNTY NORTH DAKOTA
2 305 000 FEET
765 000 FEET
T. 128 N.
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 21)
2 290 000 FEET
755 000 FEET
Spring Creek Colony


DICKEY COUNTY NORTH DAKOTA
R. 66 W.
T. 128 N.
2 310 000 FEET
765 000 FEET
775 000 FEET
2 330 000 FEET
(Joins sheet 10)
(Joins sheet 22)
BROWN COUNTY
N
1 Mile
5000 Feet
Scale 1:20000
1
2
3
10
11
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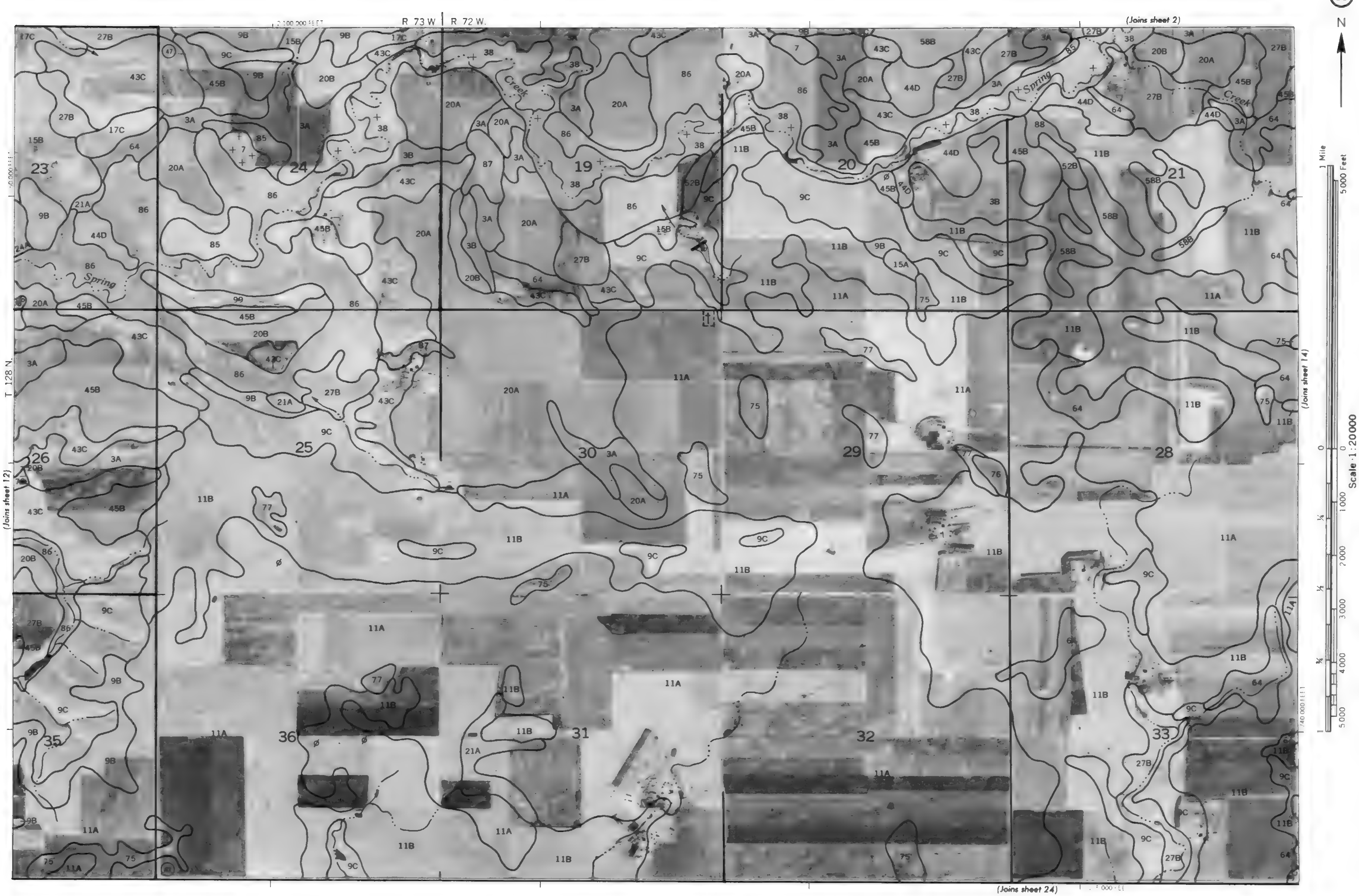
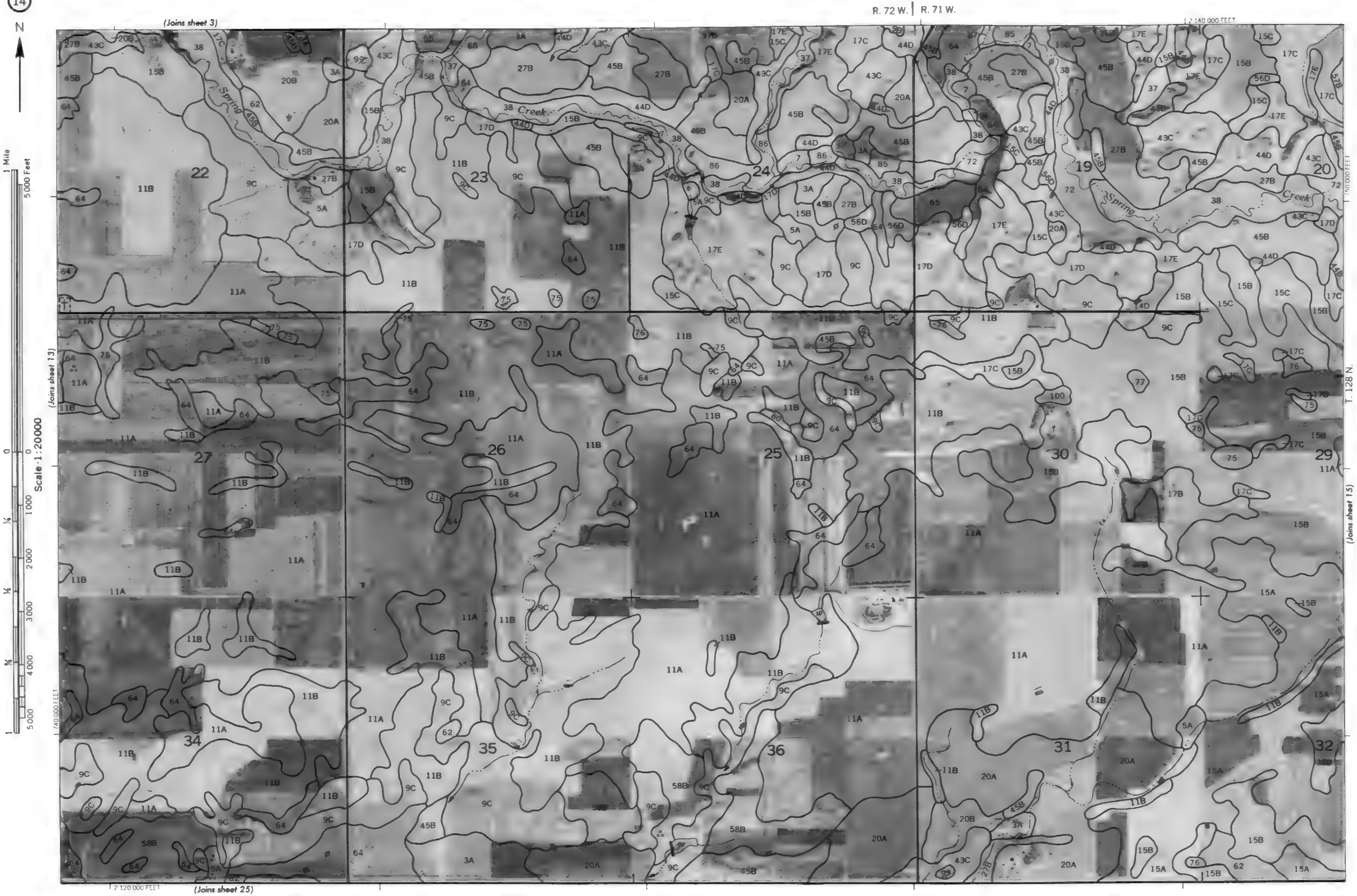
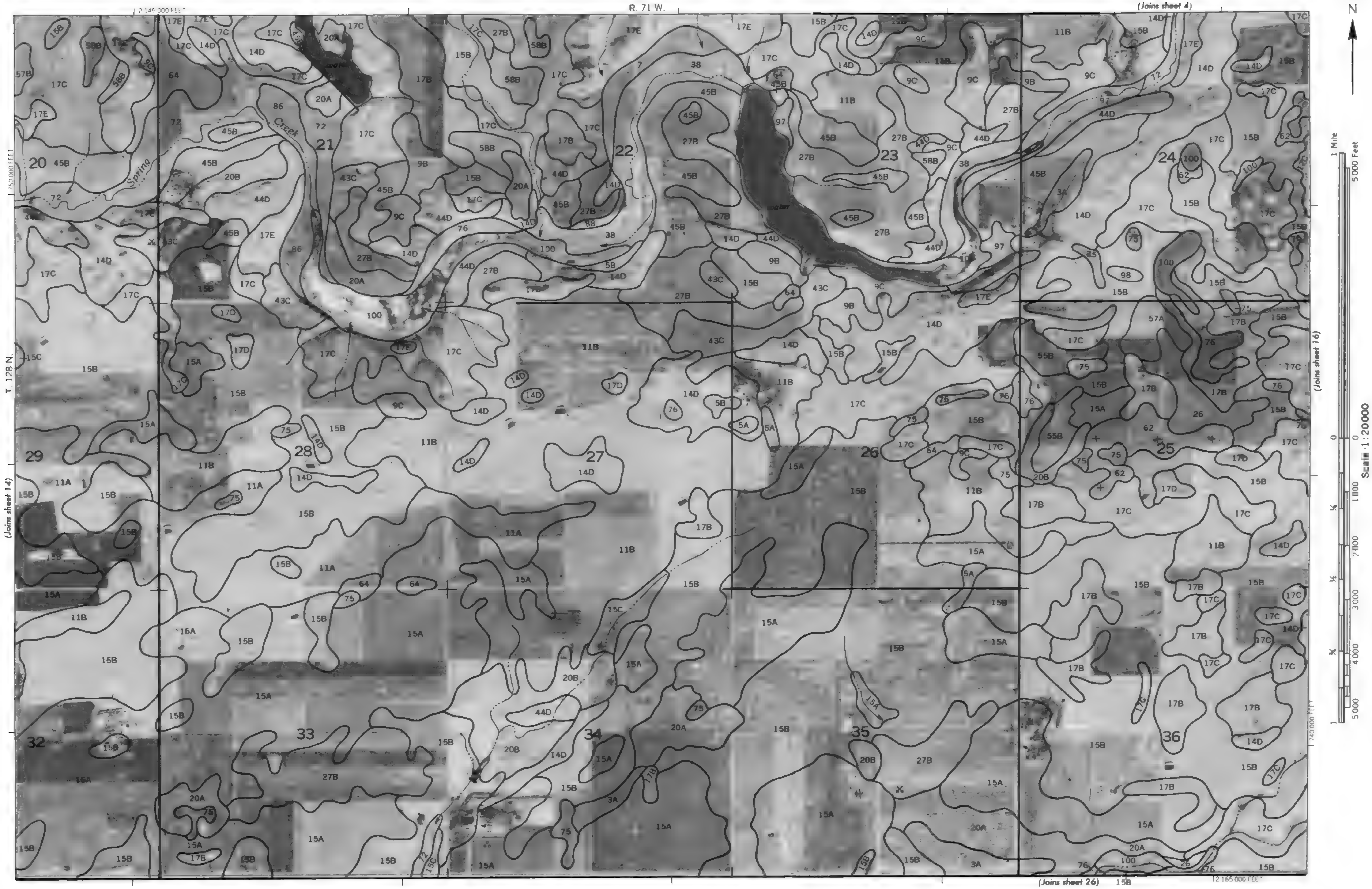
14
15

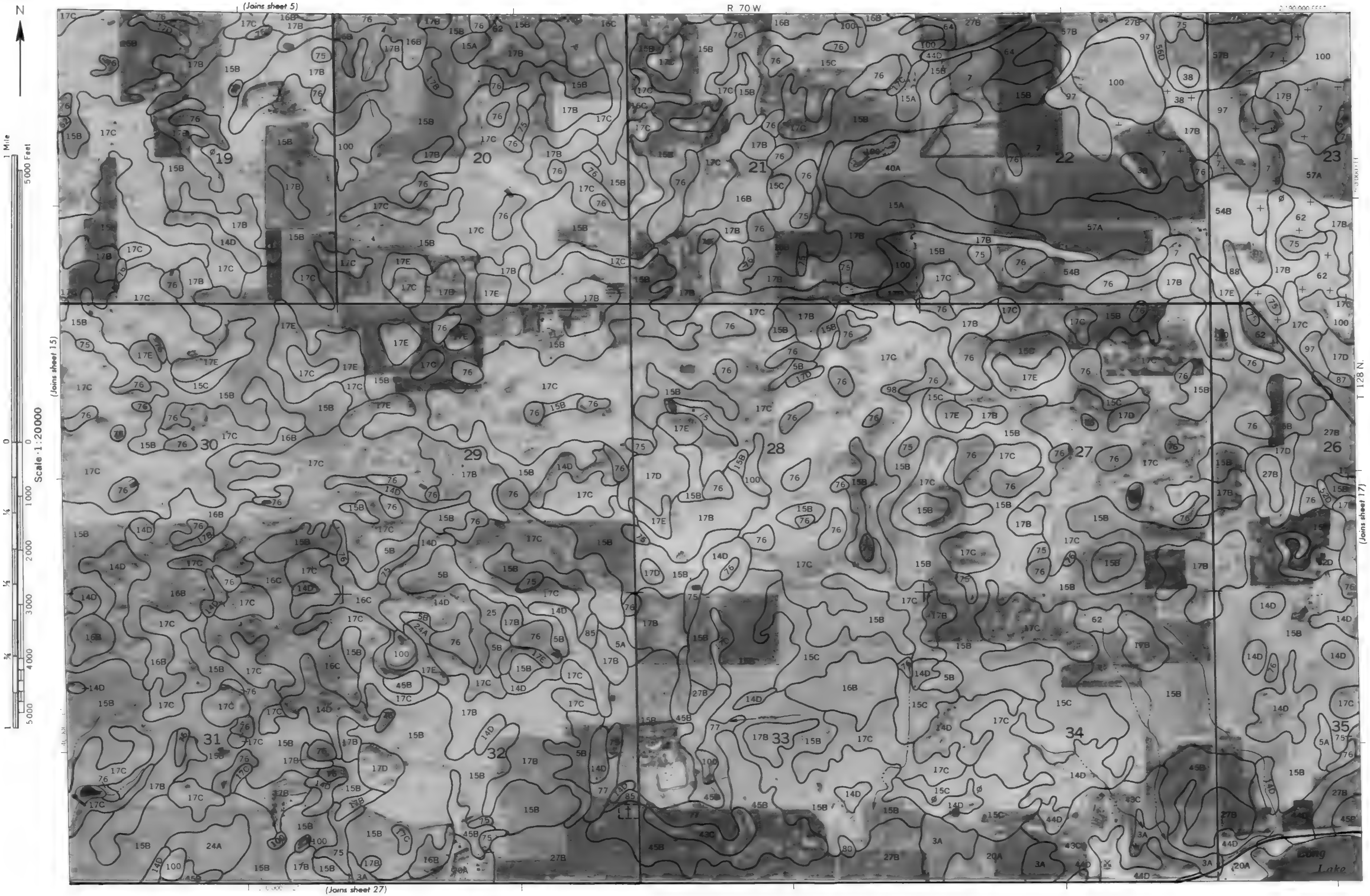
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 12

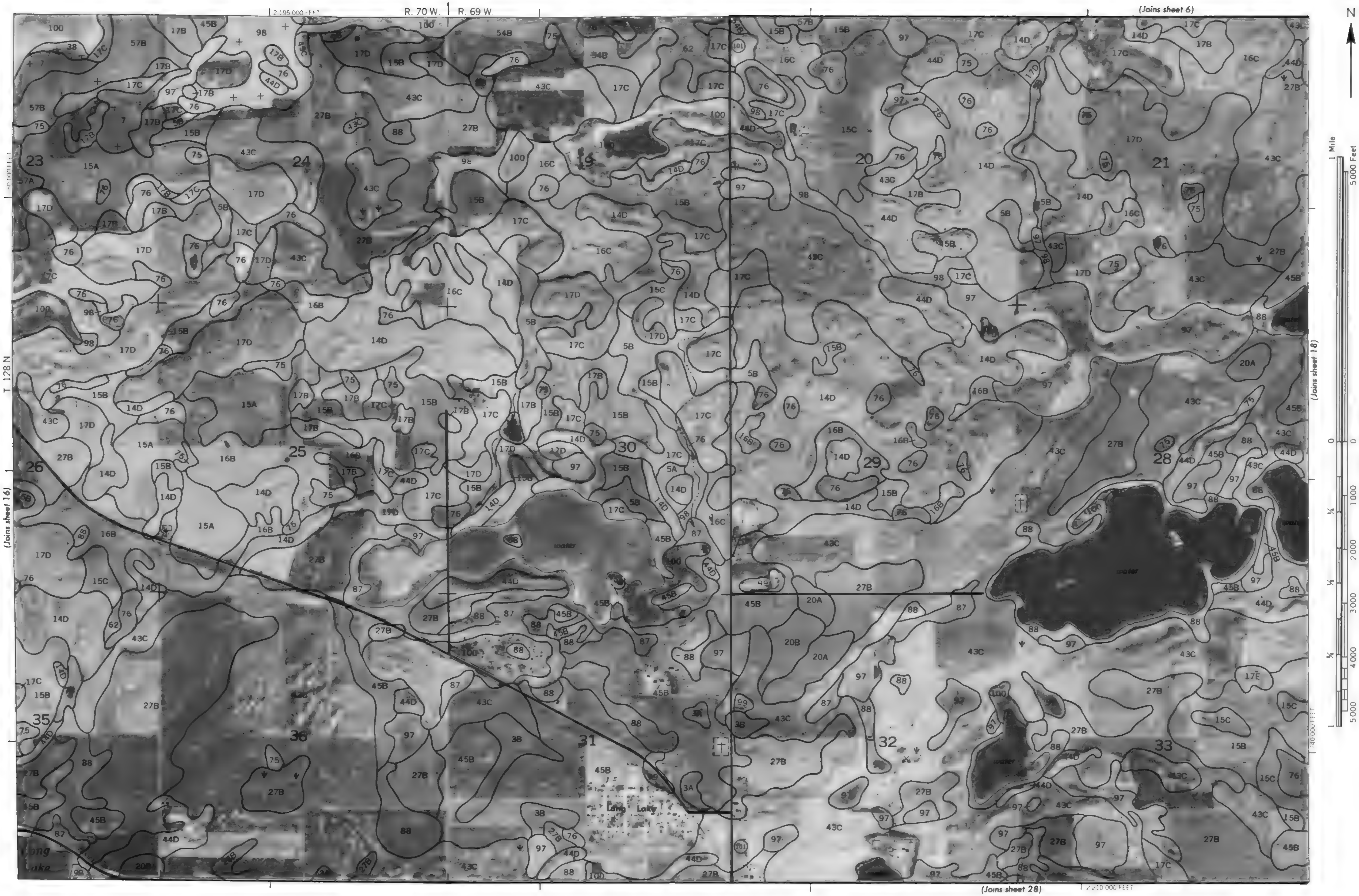

13
N
R 73 W
R 72 W.
(Joins sheet 2)
(Joins sheet 14)
(Joins sheet 24)
(Joins sheet 12)
T 128 N.
Spring Creek
Spring
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
1 Mile
5000 Feet
Scale 1:20000

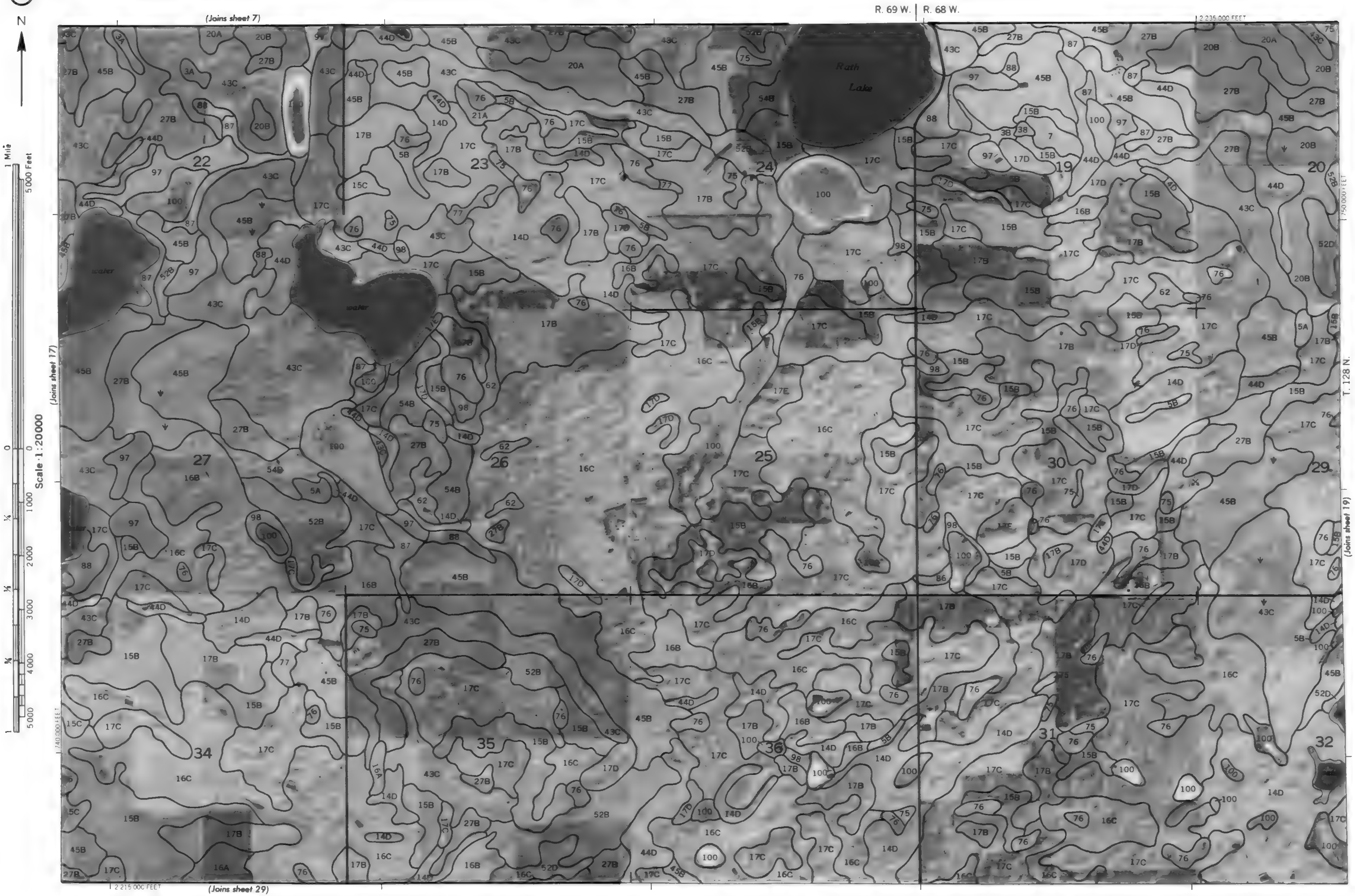
MCPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 14

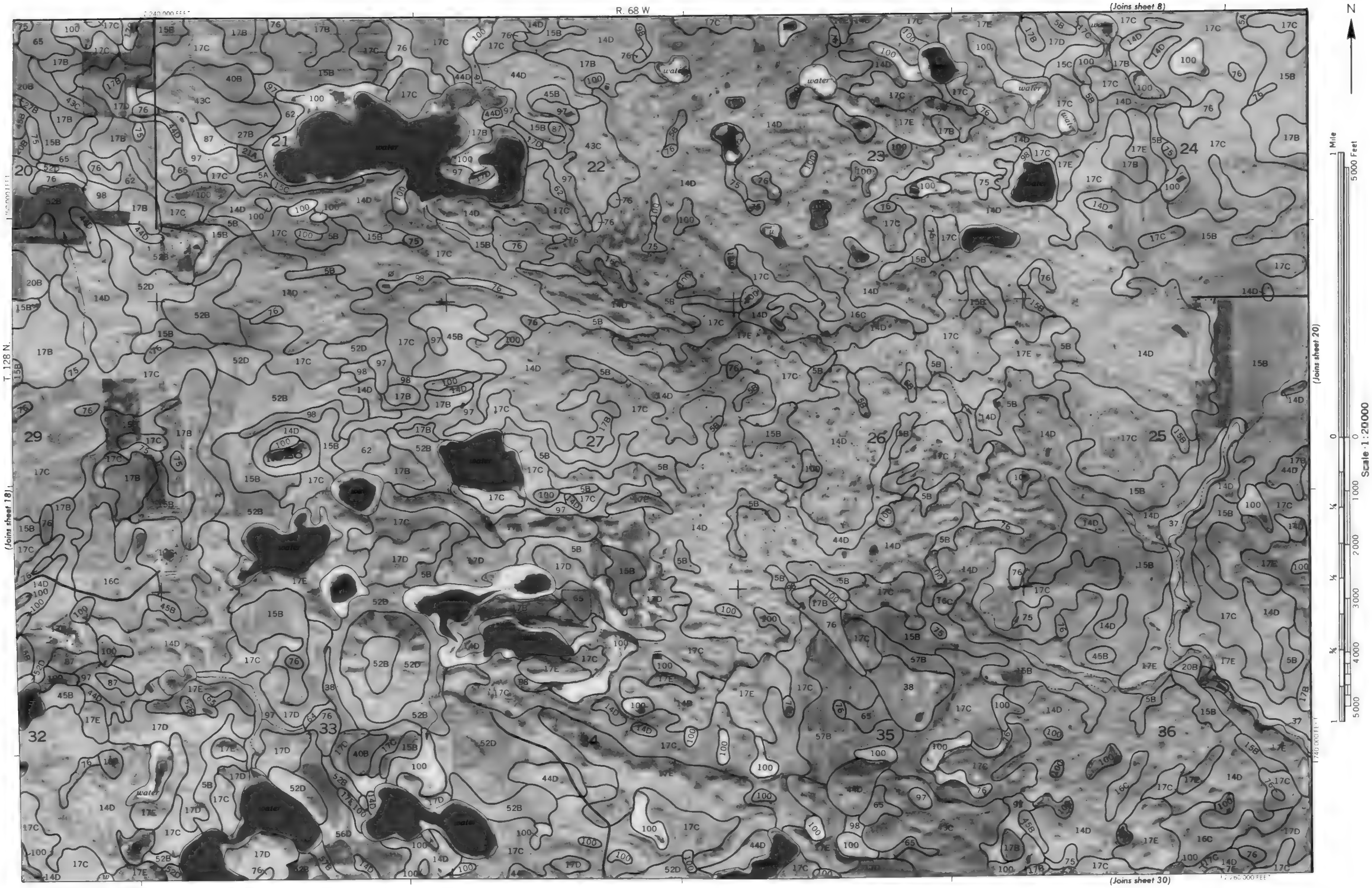


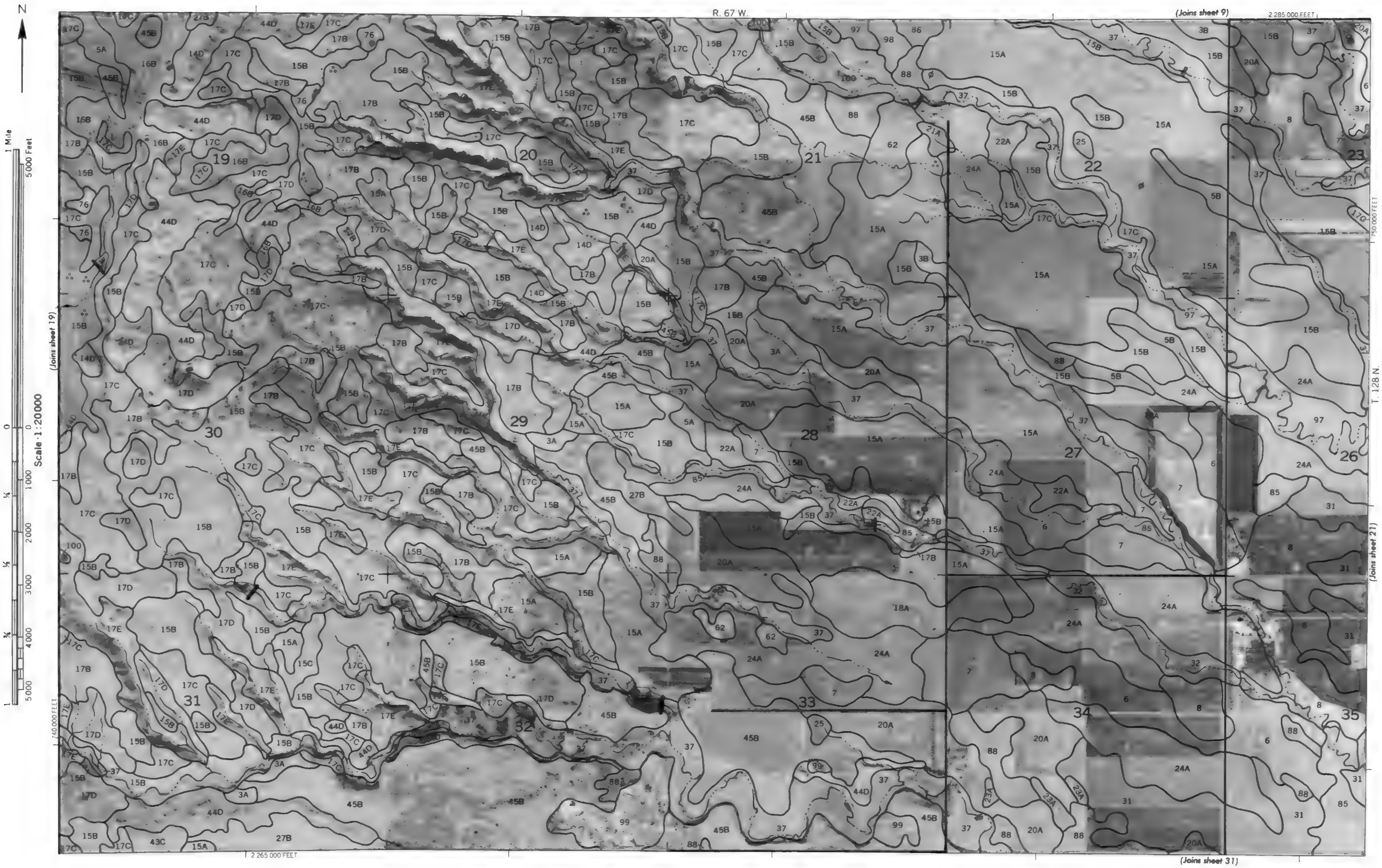

N
R. 71 W.
(Joins sheet 4)
(Joins sheet 16)
(Joins sheet 26)
(Joins sheet 14)
T. 128 N.
2 145 000 FEET
150 000 FEET
740 000 FEET
2 165 000 FEET
Spring Creek
Water
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

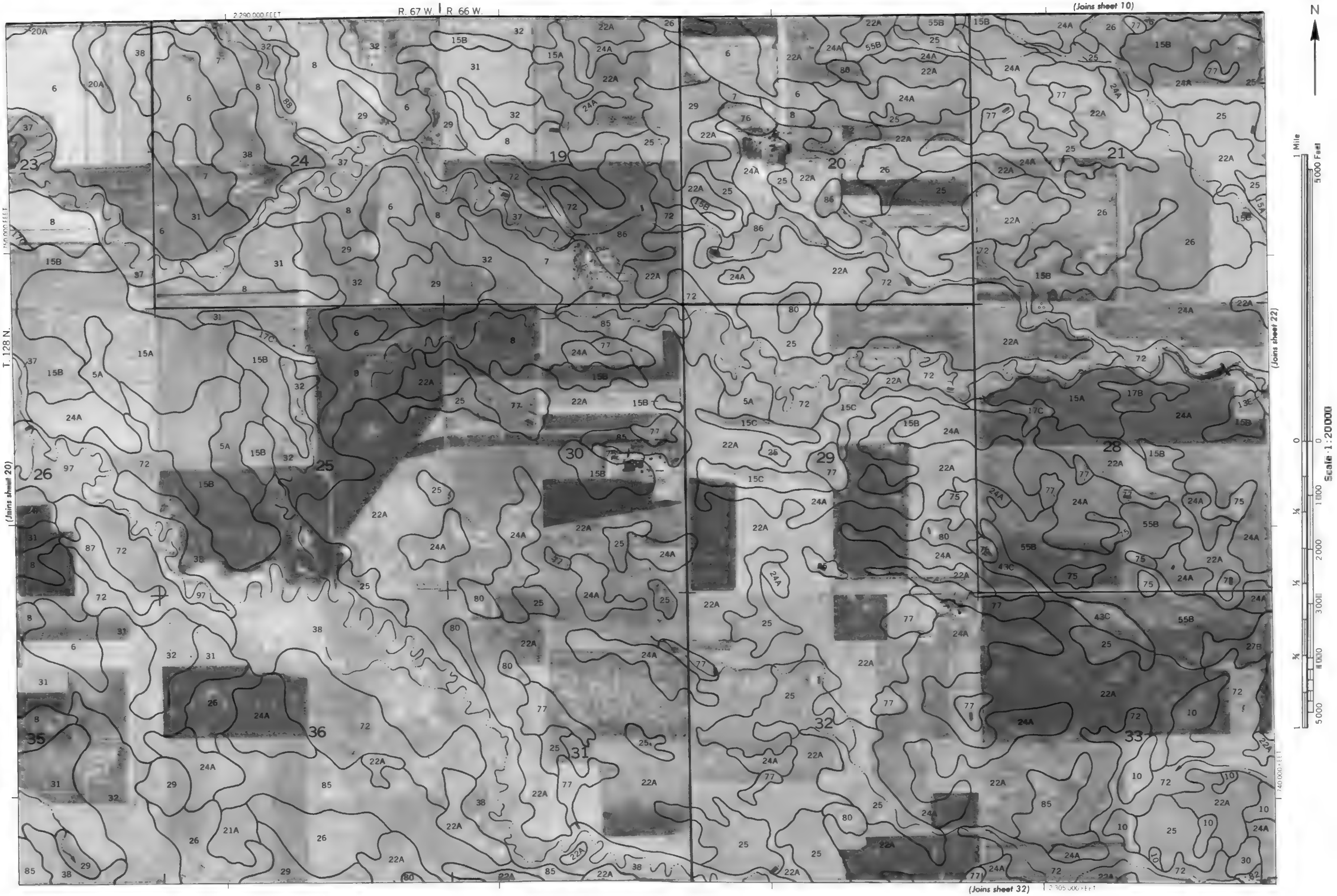

N
(Joins sheet 5)
R 70 W
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 27)
T 128 N.
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
Long
Lake


(Joins sheet 6)
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 28)
R. 70 W.
R. 69 W.
T. 128 N.
N
1 Mile
5000 Feet
Scale 1:20000
Long Lake
water
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33

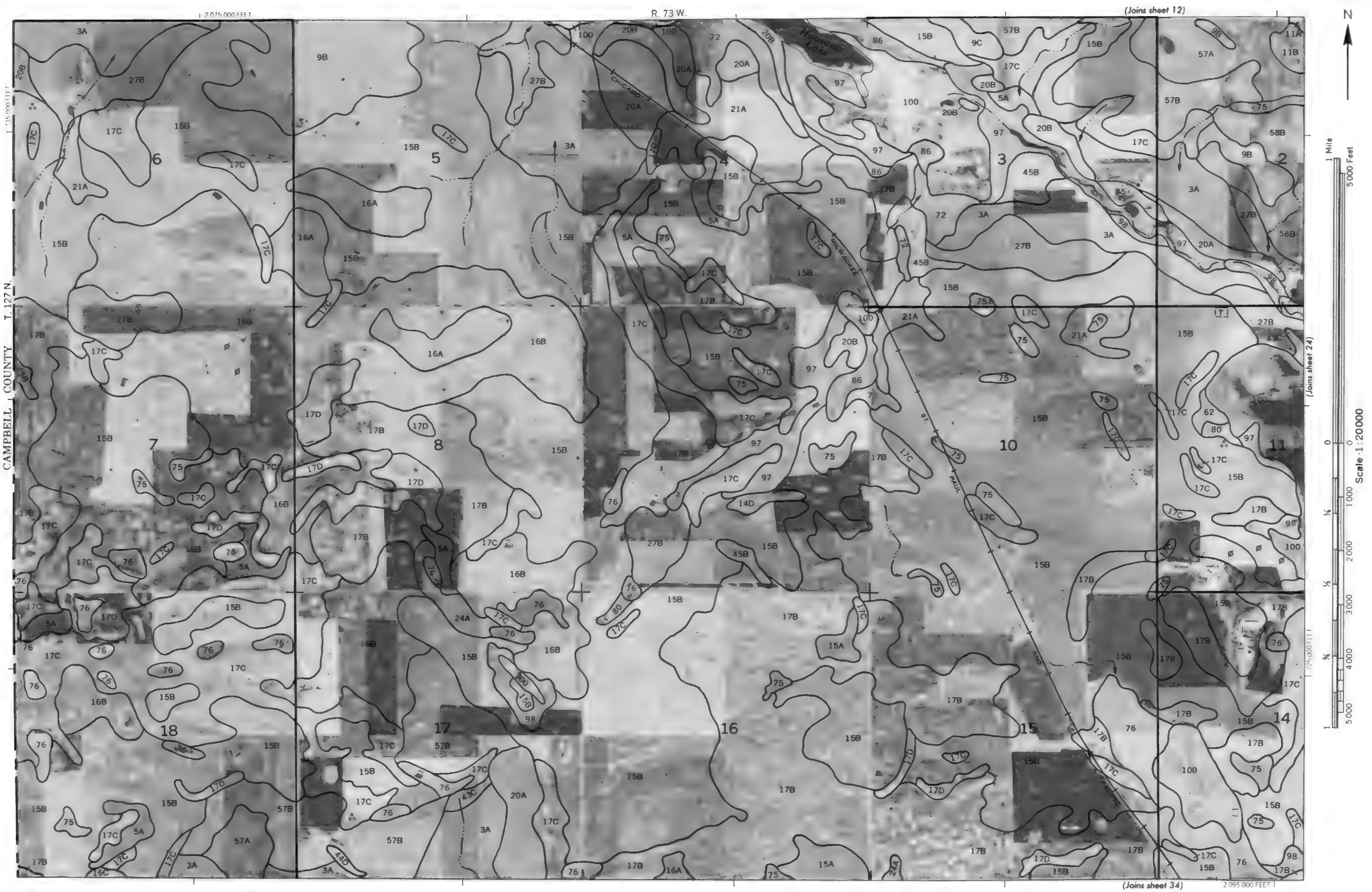

N
(Joins sheet 7)
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 29)
R. 69 W. | R. 68 W.
T. 128 N.
Rath Lake
water
1 Mile
5000 Feet
Scale 1:20000
2 235 000 FEET
750 000 FEET
740 000 FEET
2 215 000 FEET
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32

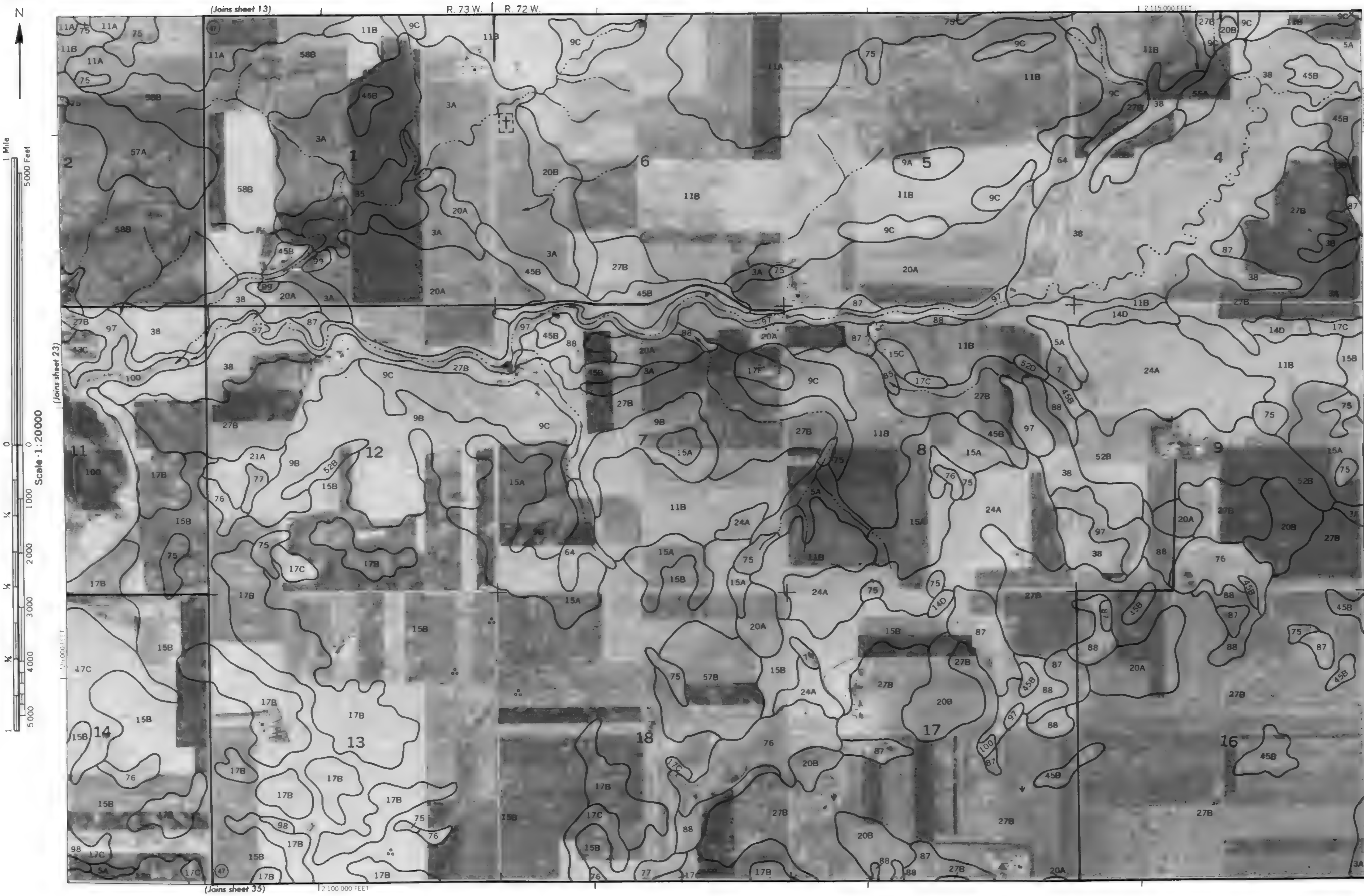

R. 68 W.
T. 128 N.
(Joins sheet 8)
(Joins sheet 20)
(Joins sheet 30)
(Joins sheet 18)
N
1 Mile
5000 Feet
Scale 1:20000

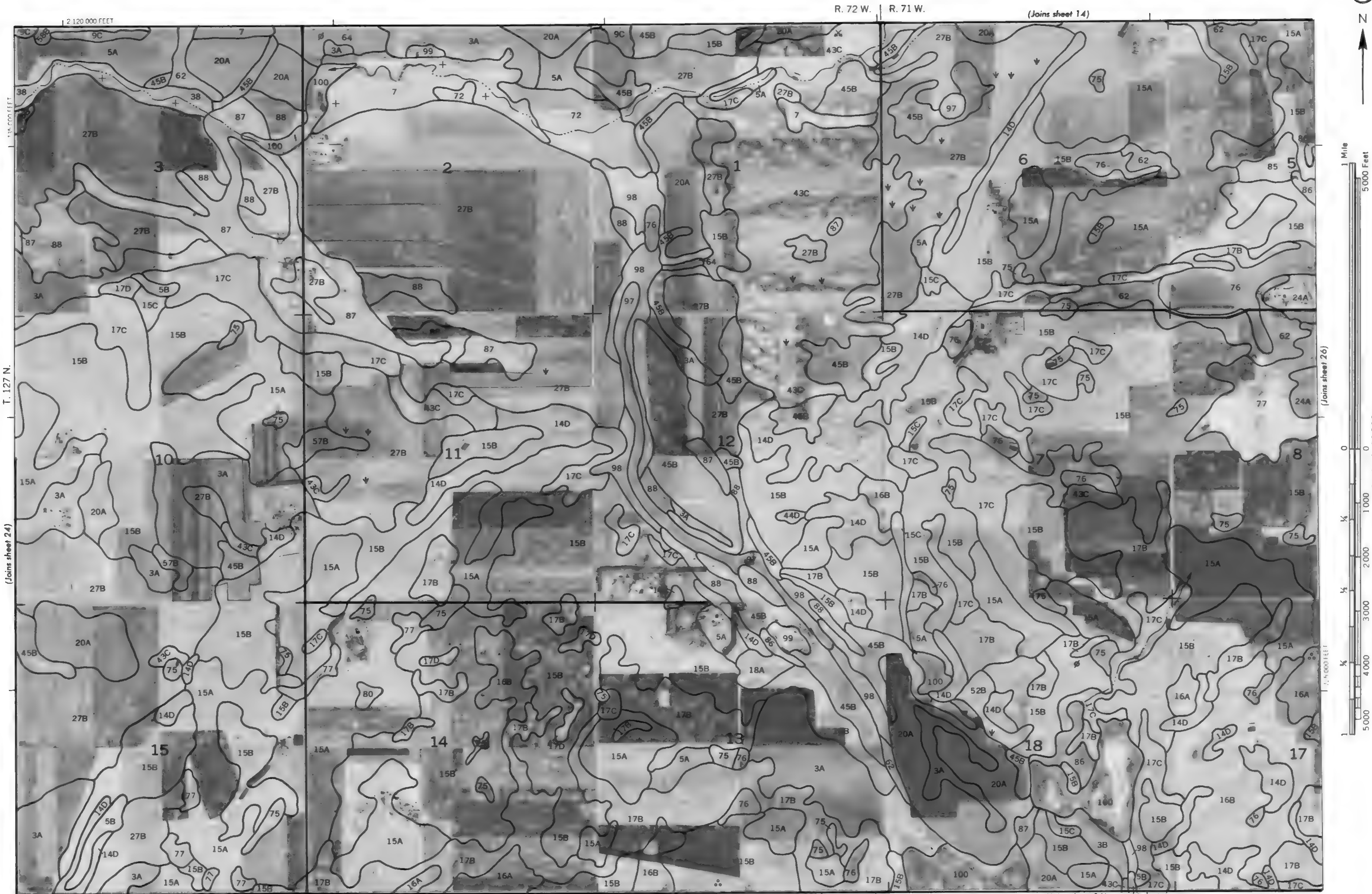

N
1 Mile
5000 Feet
Scale 1:20000
R. 67 W.
(Joins sheet 9)
2 285 000 FEET
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 31)
T. 128 N.
750 000 FEET
740 000 FEET
2 265 000 FEET
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

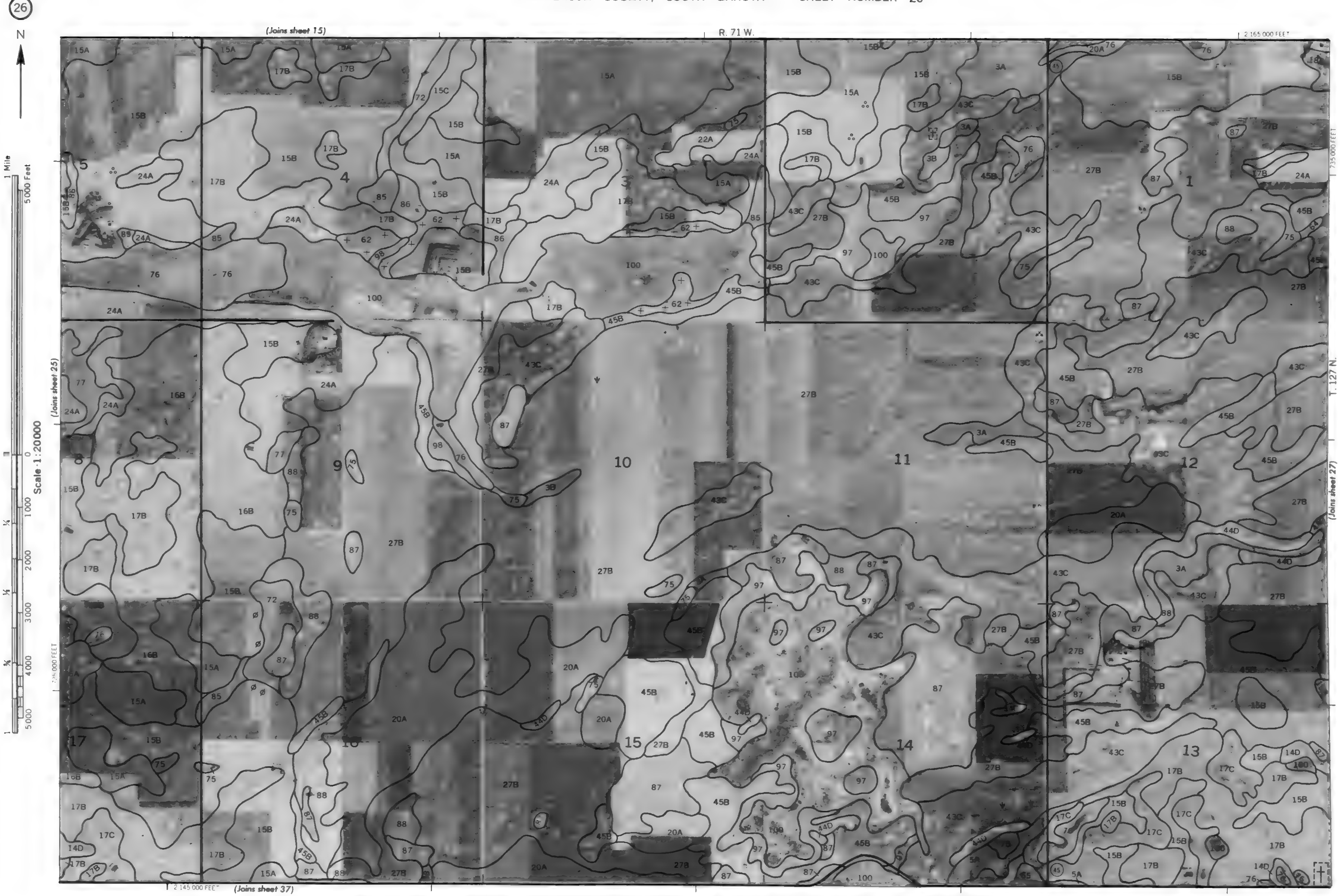

N
R. 67 W.
R. 66 W.
2 290 000 FEET
(Joins sheet 10)
(Joins sheet 22)
(Joins sheet 20)
(Joins sheet 32)
T. 128 N.
Scale 1:20000
1 Mile
5000 Feet
19
20
21
24
25
26
28
29
30
31
32
33
35
36

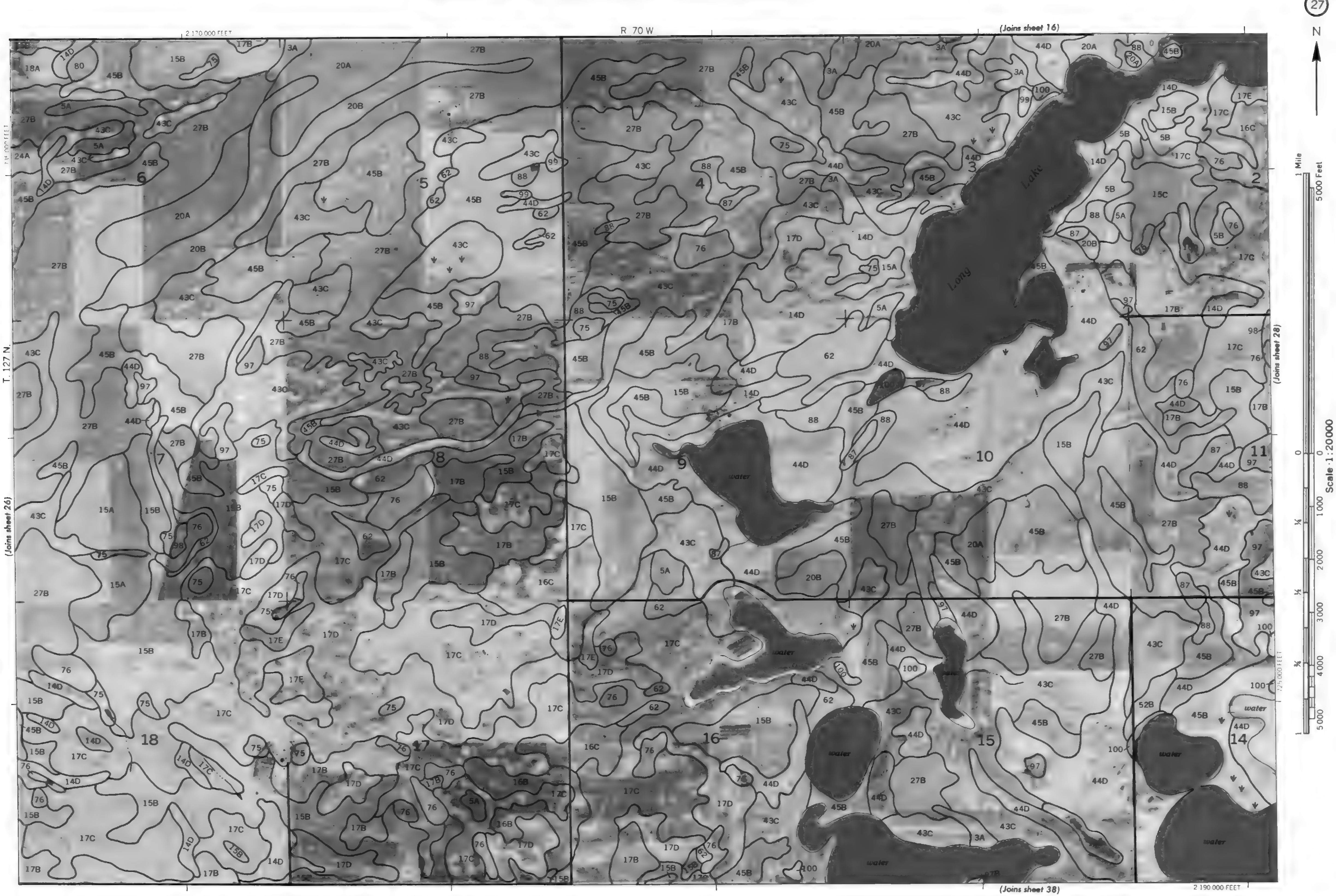

N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 11)
R. 66 W.
2 330 000 FEET
(Joins sheet 21)
750 000 FEET
T. 128 N.
BROWN COUNTY
ELM
LAKE
240 000 FEET
2 310 000 FEET
(Joins sheet 33)
22
23
24
25
26
27
34
35
36


23
N
(Joins sheet 12)
(Joins sheet 24)
(Joins sheet 34)
R. 73 W.
T. 127 N.
CAMPBELL COUNTY
2 075 000 FEET
2 095 000 FEET
Hausauer Lake
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
1000
2000
3000
4000
5000

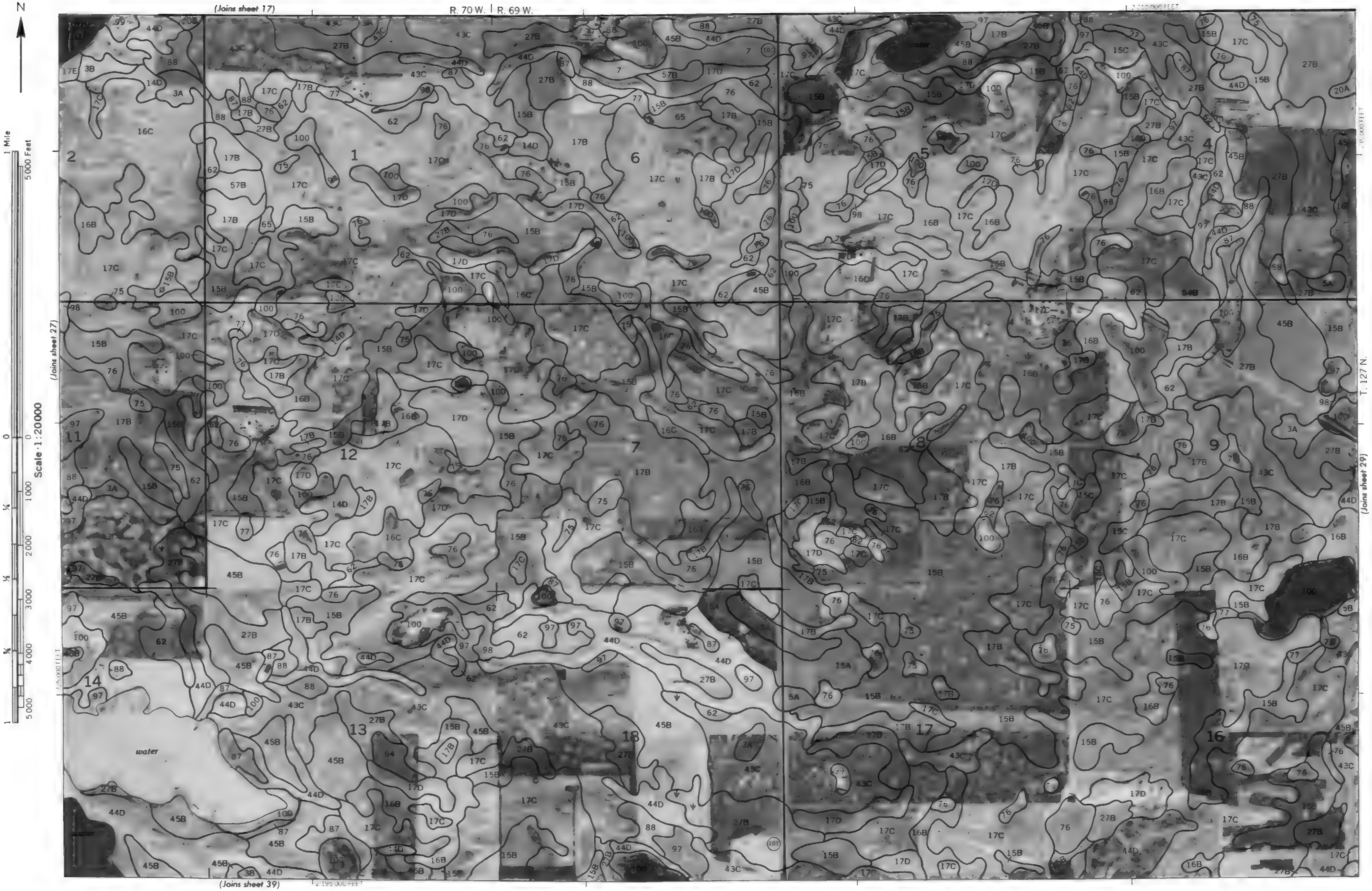

N
(Joins sheet 13)
R. 73 W.
R. 72 W.
2 115 000 FEET
735 000 FEET
T. 127 N.
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 35)
2 100 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18

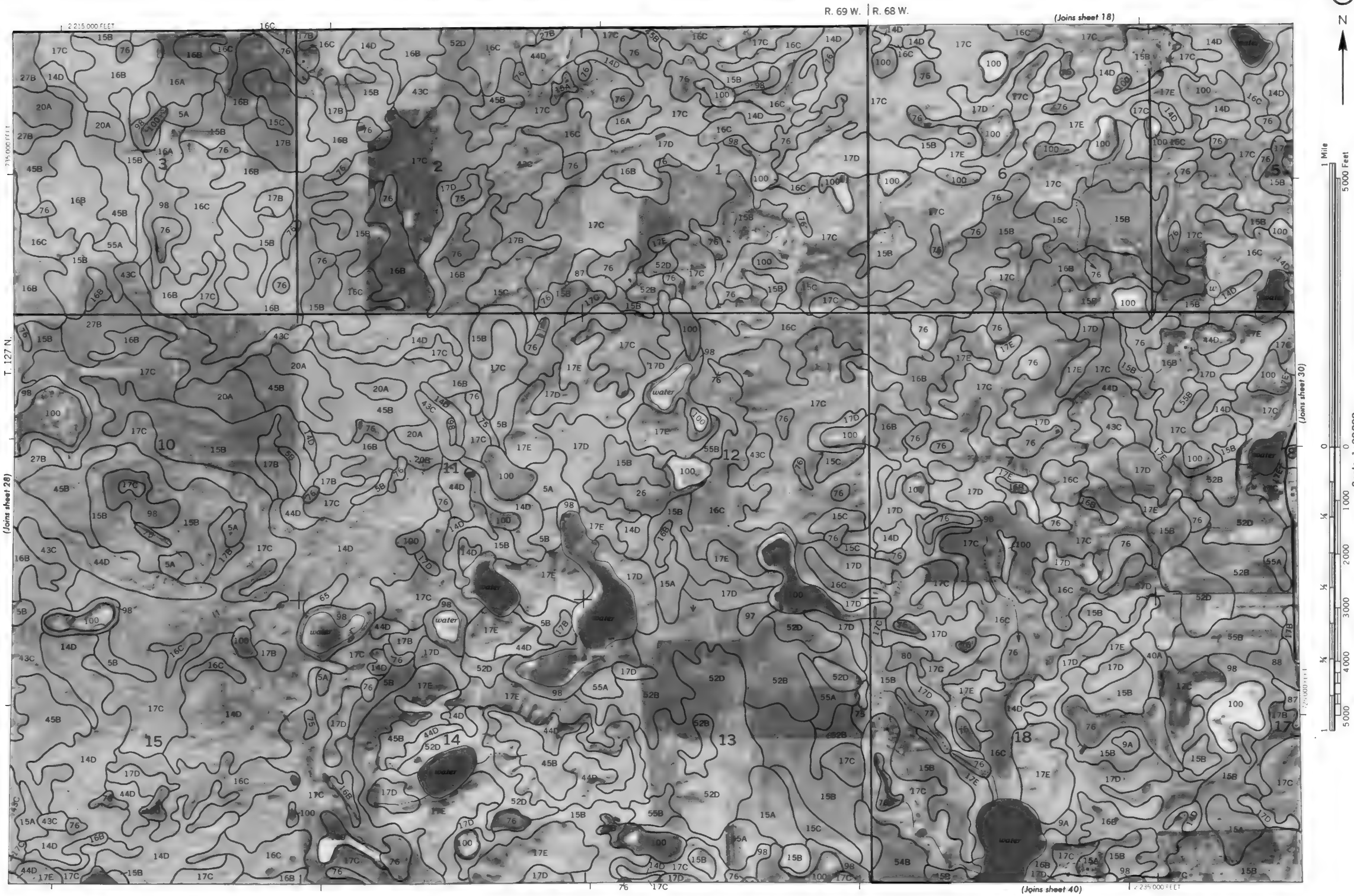

25
N
R. 72 W.
R. 71 W.
(Joins sheet 14)
(Joins sheet 26)
(Joins sheet 24)
(Joins sheet 36)
T. 127 N.
2 120 000 FEET
2 140 000 FEET
1 Mile
5000 Feet
Scale 1:20 000
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18

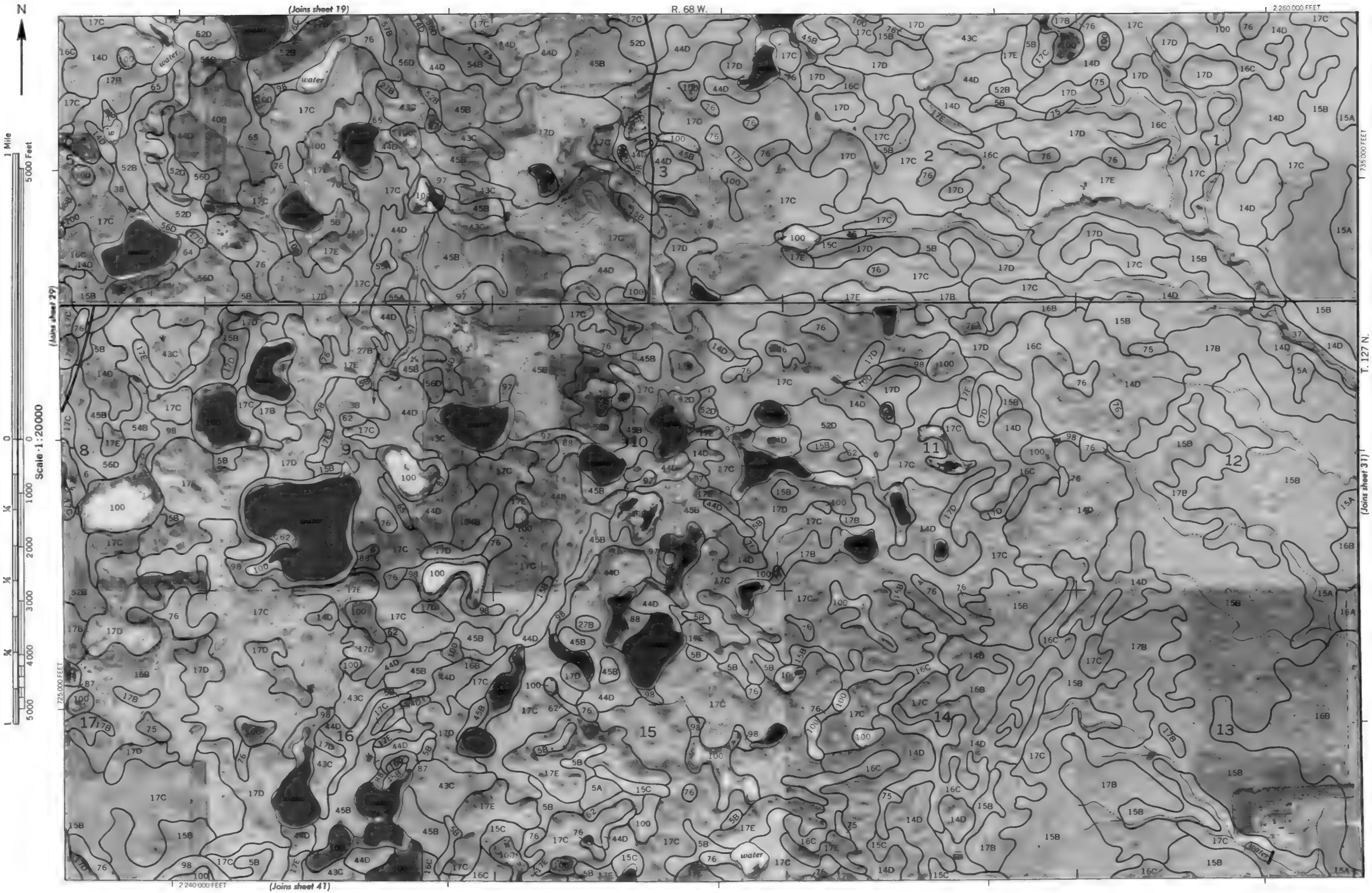

26
N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 15)
R. 71 W.
2 165 000 FEET
(Joins sheet 25)
(Joins sheet 27)
T. 127 N.
735 000 FEET
2 145 000 FEET
(Joins sheet 37)
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

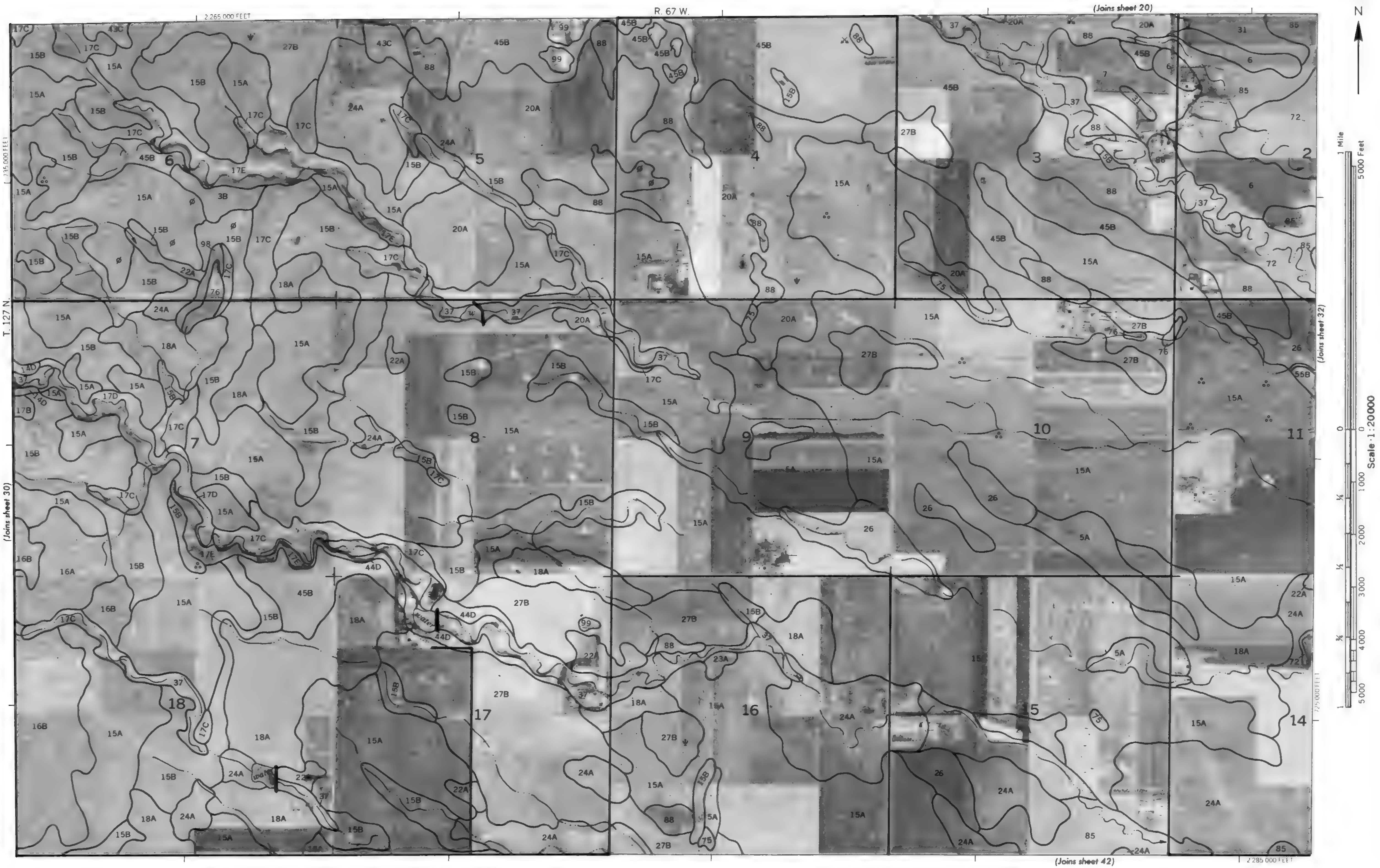

27
N
(Joins sheet 16)
R. 70 W.
T. 127 N.
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 38)
2 190 000 FEET
Long Lake
water
1 Mile
5000 Feet
Scale 1:20000

(28)

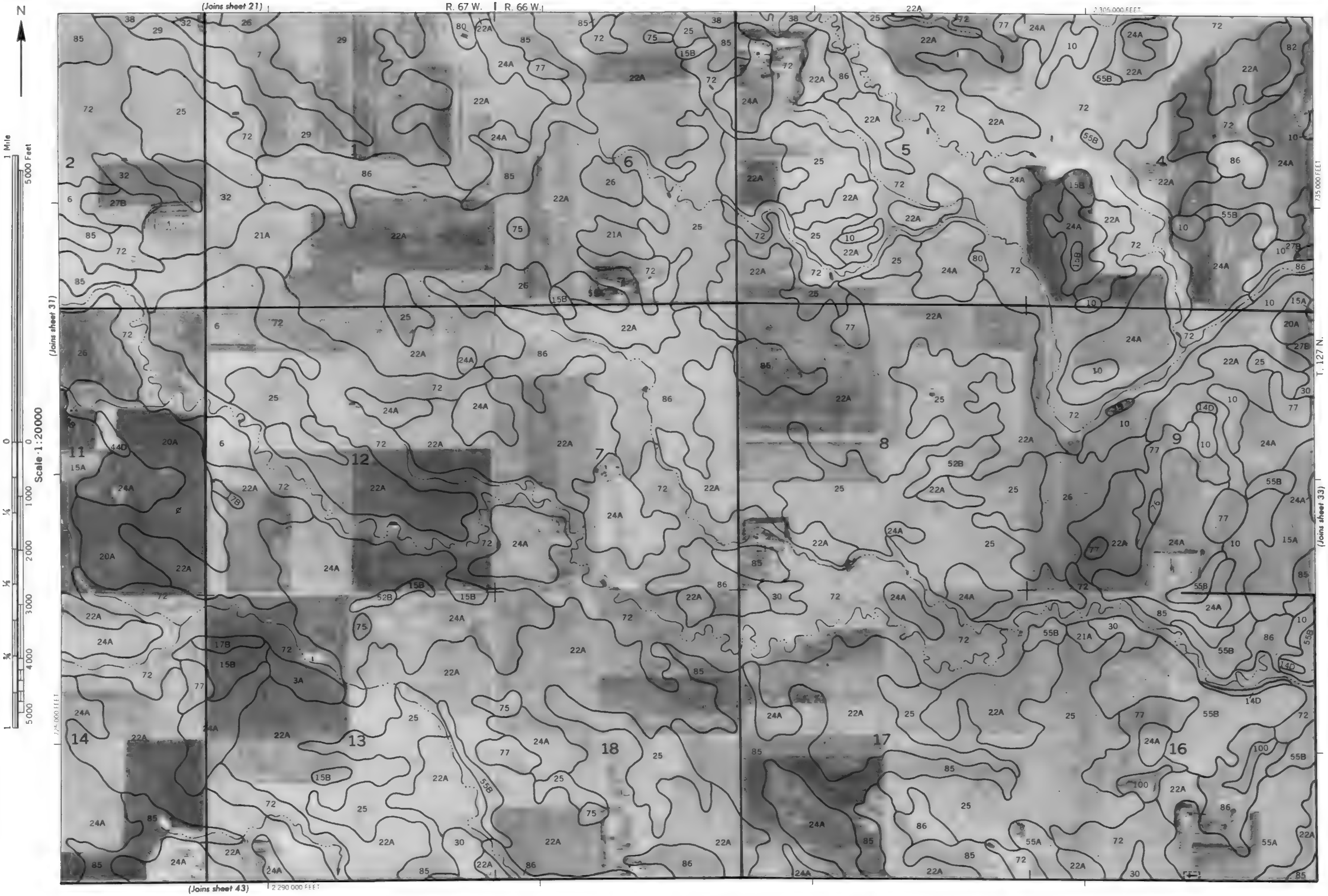

N
(Joins sheet 17)
R. 70 W. | R. 69 W.
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 39)
T. 127 N.
1 Mile
5000 Feet
Scale 1:20 000
0
1000
2000
3000
4000
5000
water
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18

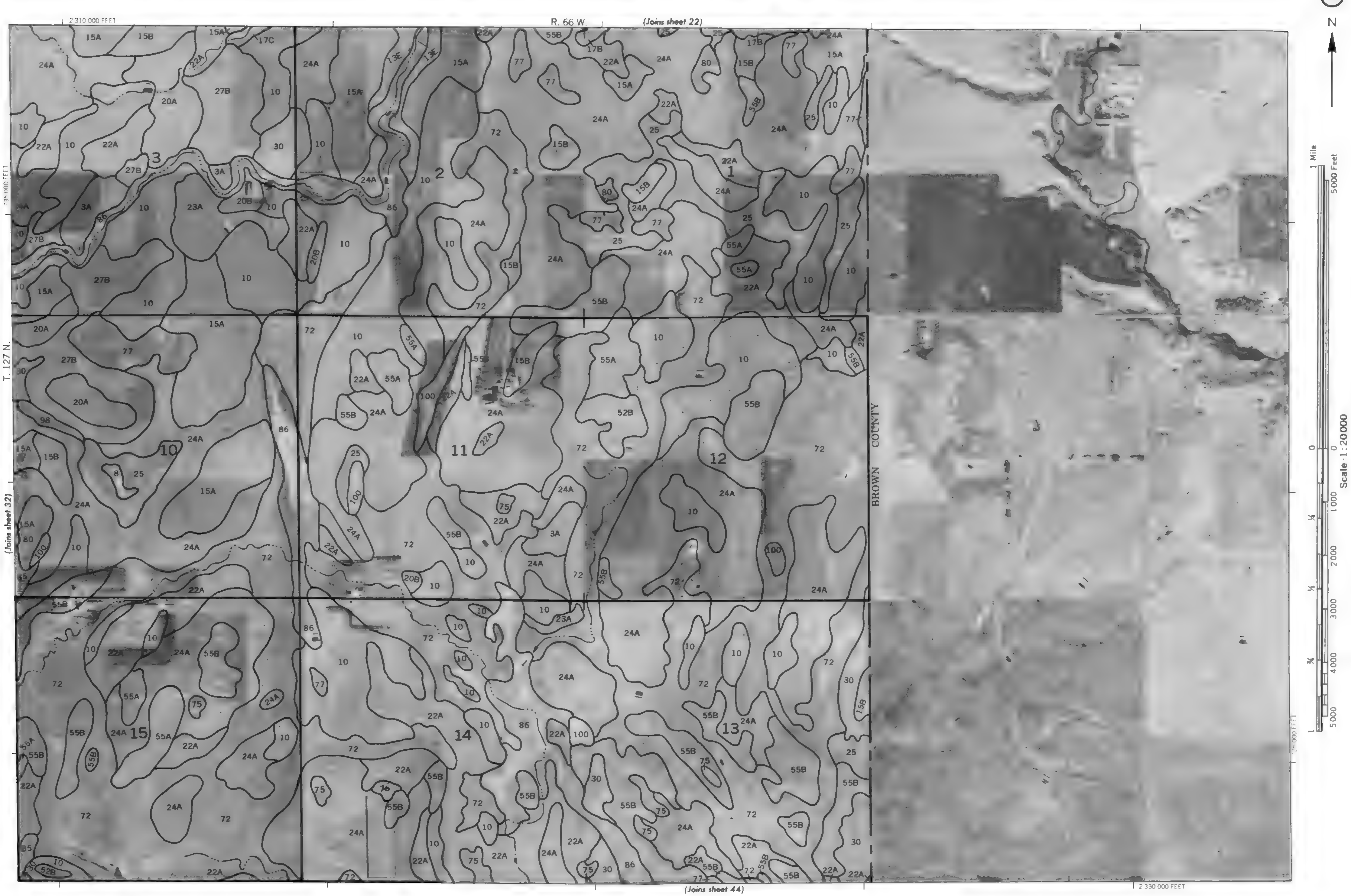

R. 69 W.
R. 68 W.
(Joins sheet 18)
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 40)
T. 127 N.
2 235 000 FEET
N
1 Mile
5000 Feet
Scale 1:20 000
1
2
3
5
6
7
10
11
12
13
14
15
17
18
water

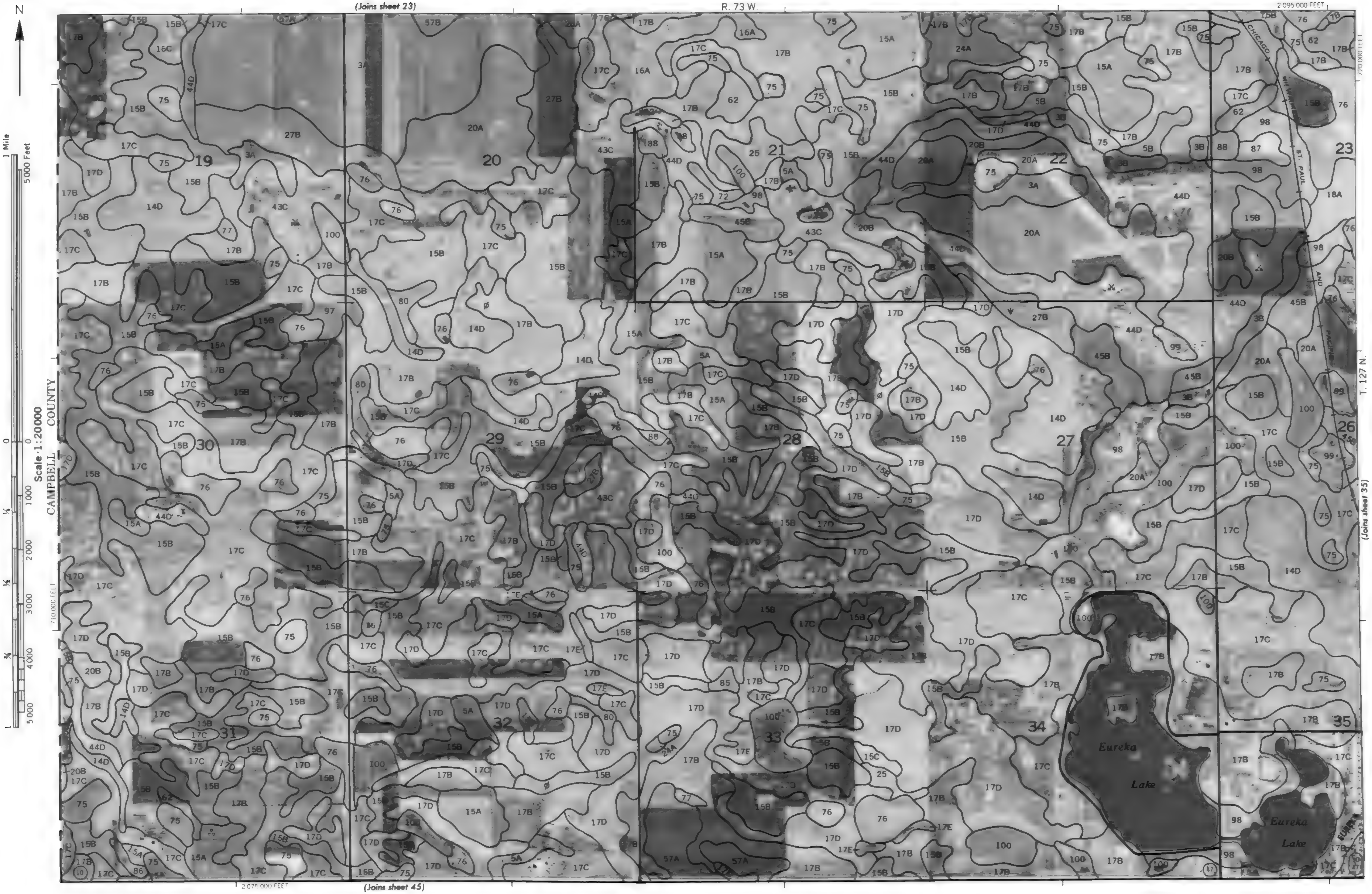

N
(Joins sheet 19)
R. 68 W.
2 260 000 FEET
735 000 FEET
T. 127 N.
(Joins sheet 31)
(Joins sheet 29)
(Joins sheet 41)
2 240 000 FEET
725 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
water

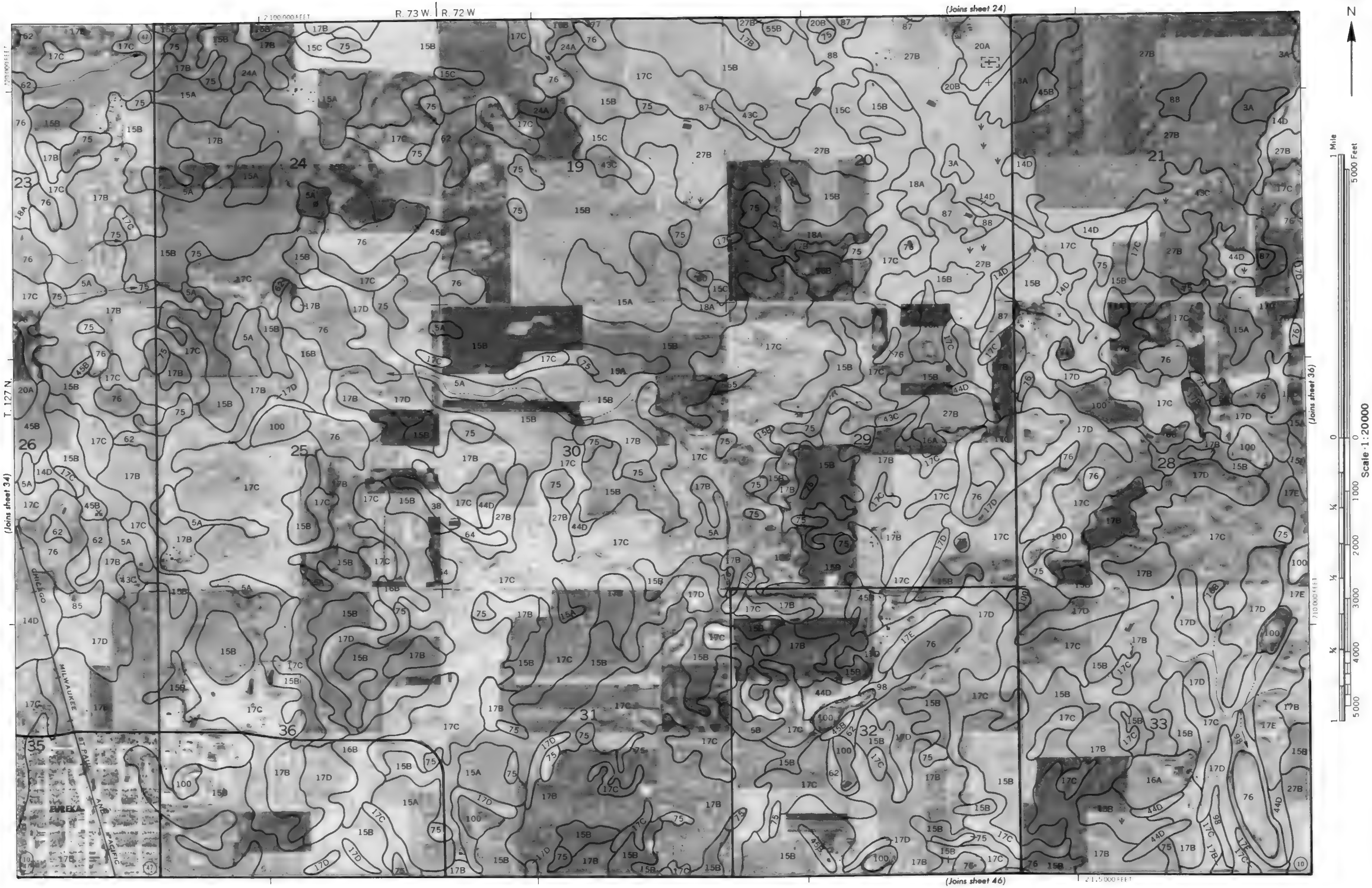


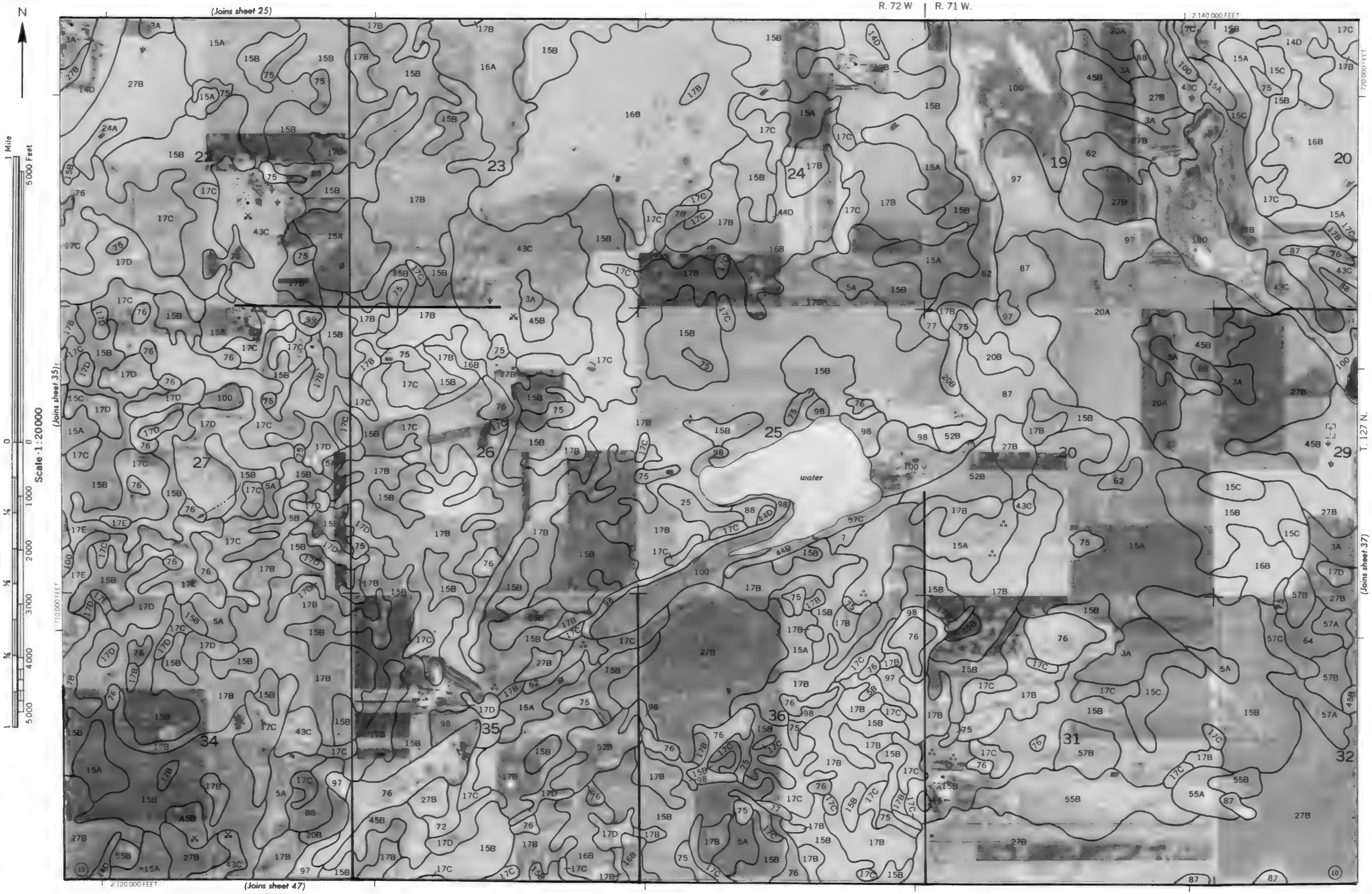
31
R. 67 W.
(Joins sheet 20)
T. 127 N.
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 42)
2 265 000 FEET
2 285 000 FEET
735 000 FEET
725 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000

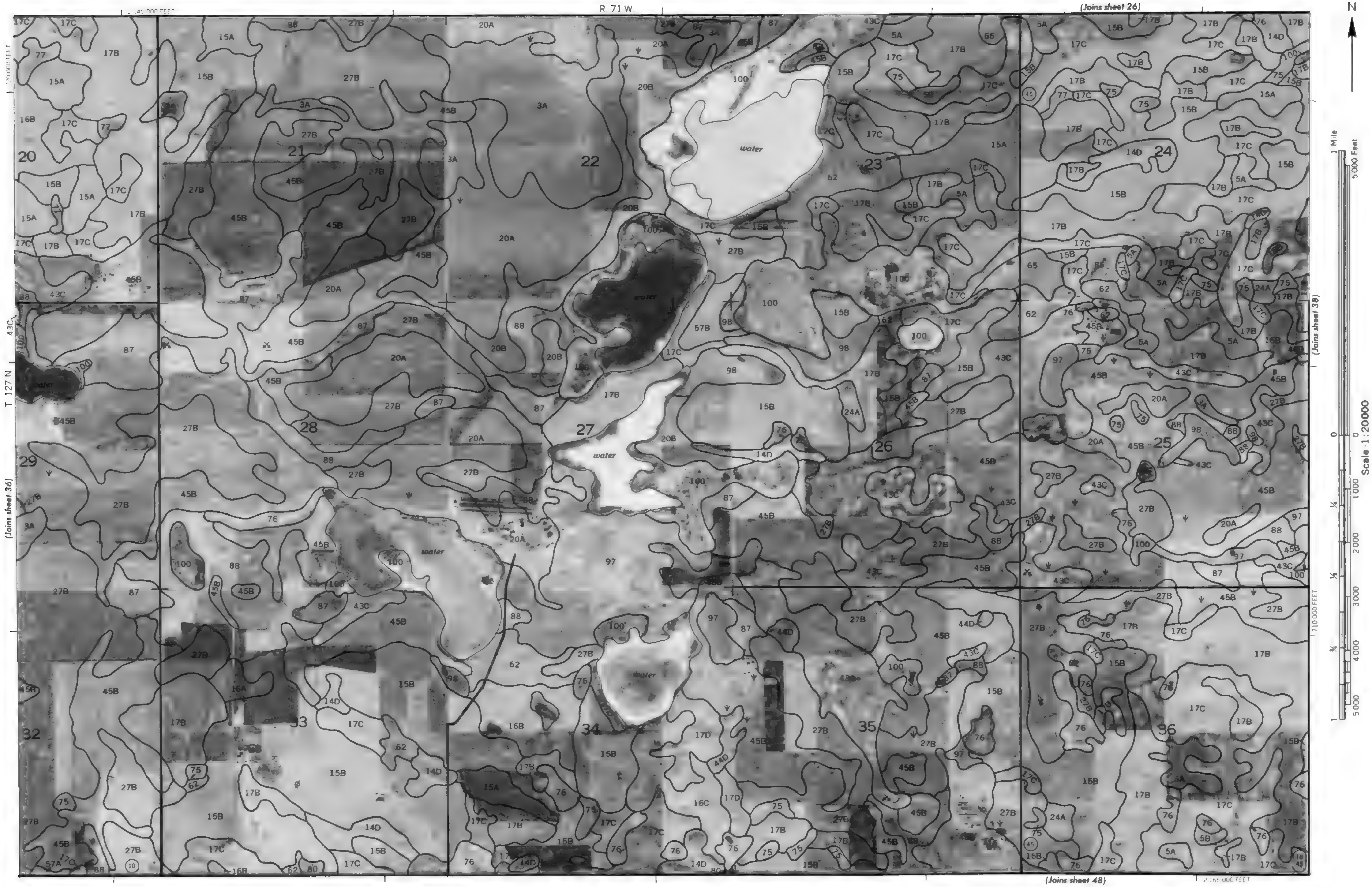

N
(Joins sheet 21)
R. 67 W.
R. 66 W.
2 305 000 FEET
(Joins sheet 31)
(Joins sheet 33)
735 000 FEET
T. 127 N.
725 000 FEET
(Joins sheet 43)
2 290 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18


33
N
R. 66 W.
(Joins sheet 22)
2 310 000 FEET
T. 127 N.
(Joins sheet 32)
BROWN COUNTY
(Joins sheet 44)
2 330 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000

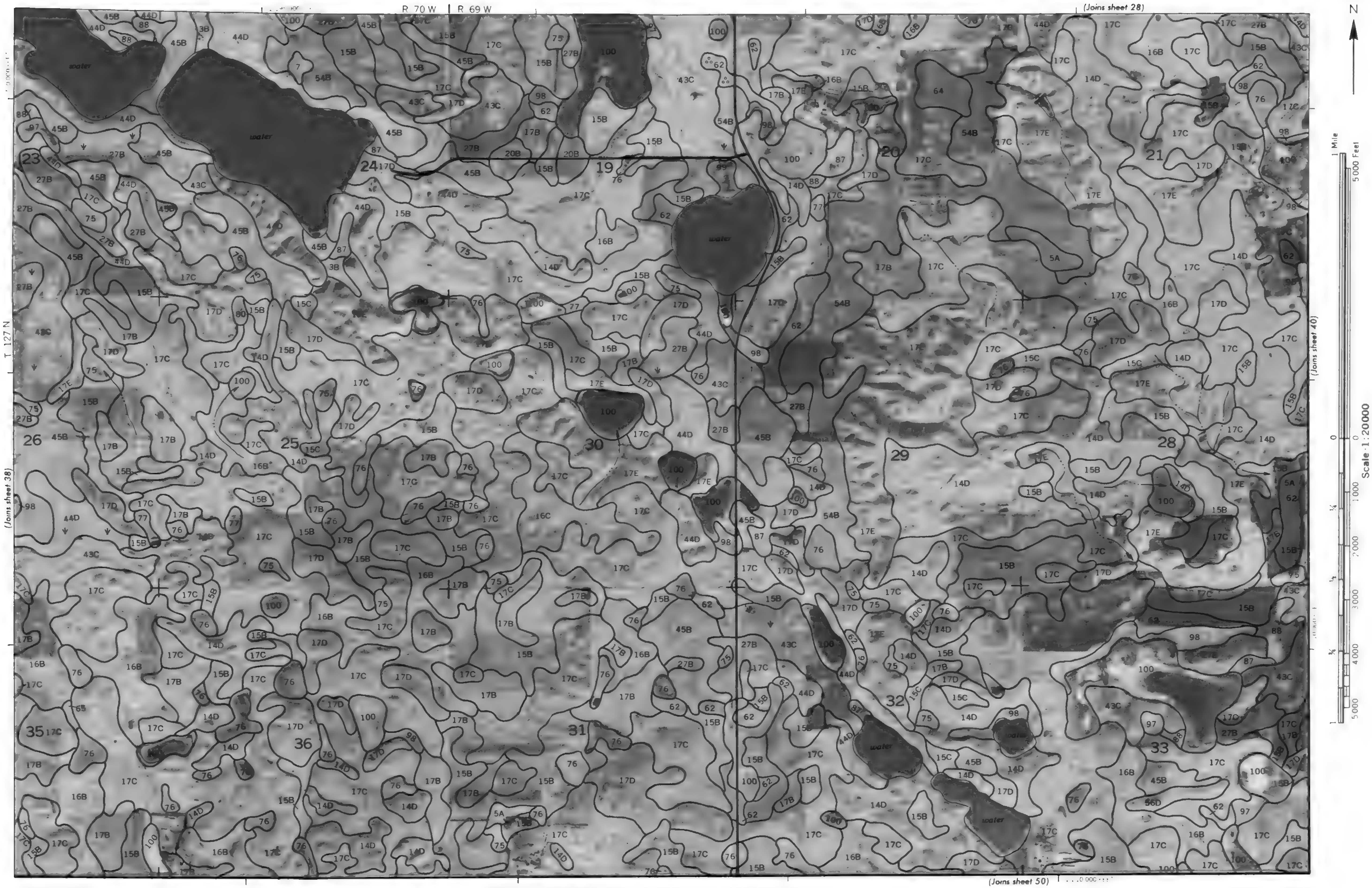

34
N
(Joins sheet 23)
R. 73 W.
2 095 000 FEET
720 000 FEET
T. 127 N.
(Joins sheet 35)
(Joins sheet 45)
2 075 000 FEET
710 000 FEET
CAMPBELL COUNTY
Scale 1:20000
1 Mile
5000 Feet
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
Eureka Lake
Eureka Lake

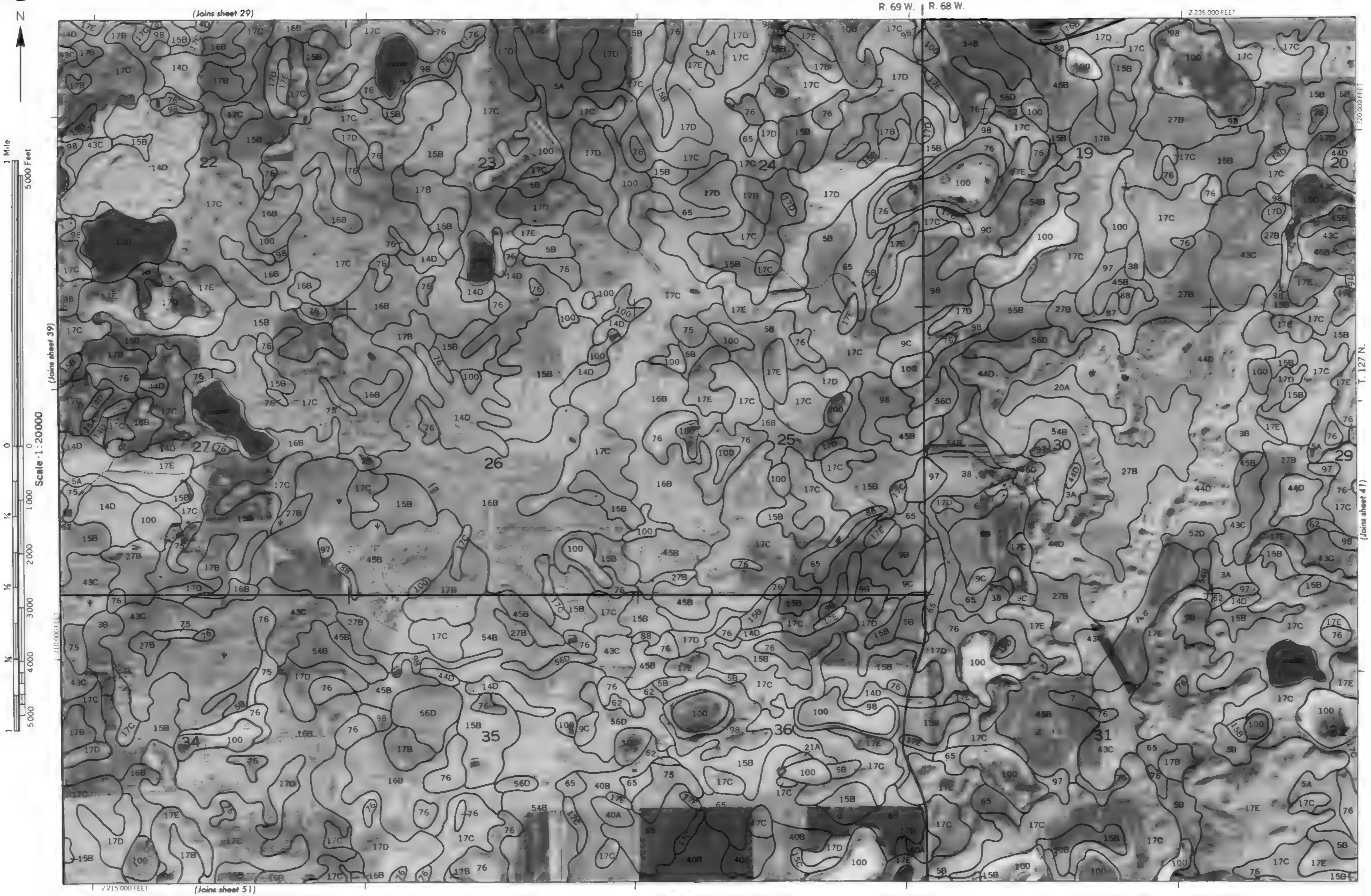

35
N
(Joins sheet 24)
(Joins sheet 46)
(Joins sheet 34)
(Joins sheet 36)
R. 73 W.
R. 72 W.
T. 127 N.
2 100 000 FEET
21 9000 FEET
EUREKA
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
19
20
21
24
25
26
28
29
30
31
32
33
35
36


N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 25)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 47)
R. 72 W.
R. 71 W.
T. 127 N.
2 140 000 FEET
2 120 000 FEET
710 000 FEET
720 000 FEET
water
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36


R. 71 W.
T. 127 N.
(Joins sheet 26)
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 48)
N
1 Mile
5000 Feet
Scale 1:20000
water

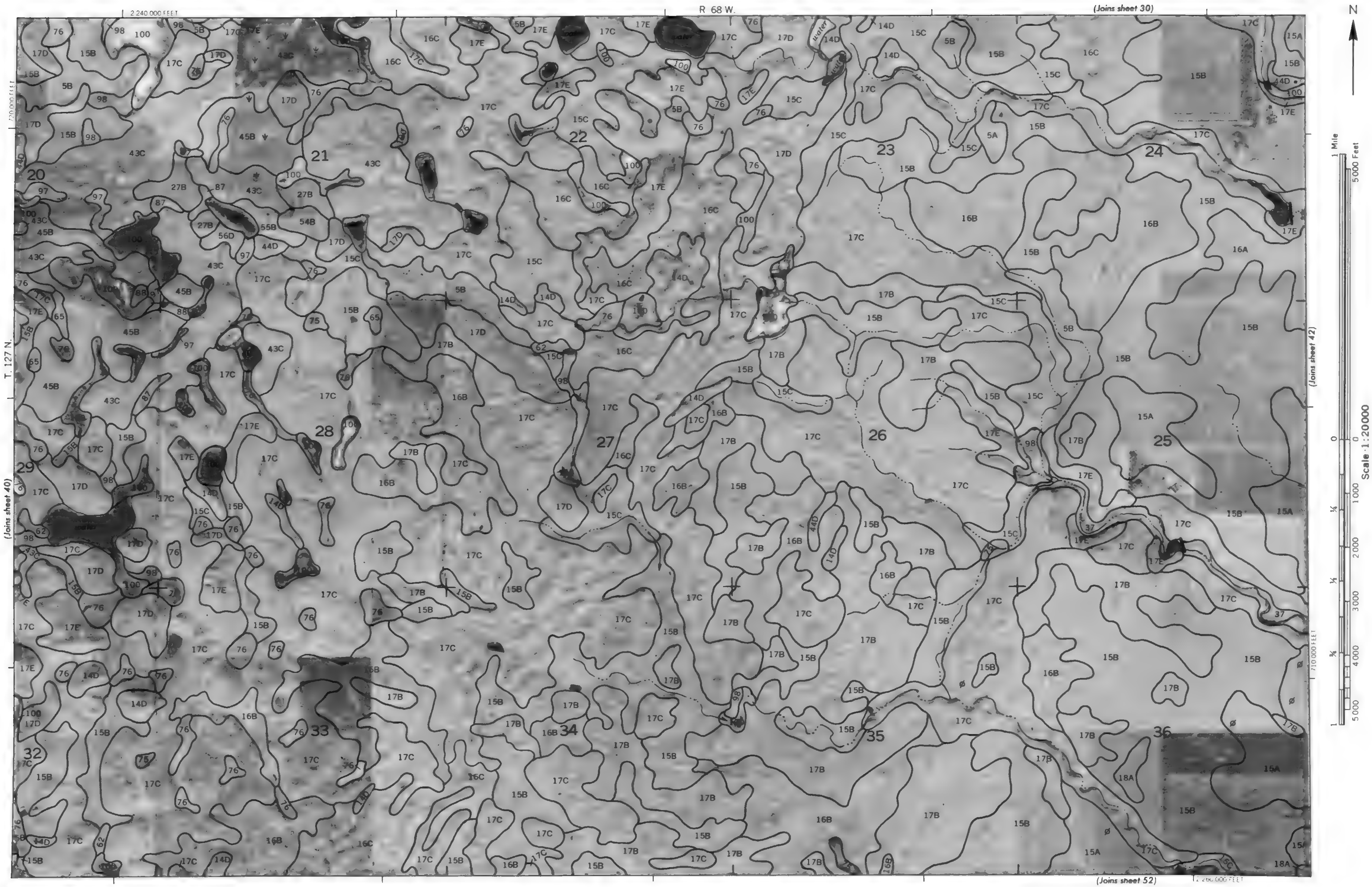

N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 27)
R. 70 W.
T. 127 N.
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 49)
2 170 000 FEET
2 190 000 FEET
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


R 70 W
R 69 W
T 127 N
(Joins sheet 28)
(Joins sheet 40)
(Joins sheet 38)
(Joins sheet 50)
N
1 Mile
5000 Feet
Scale 1:20000
water

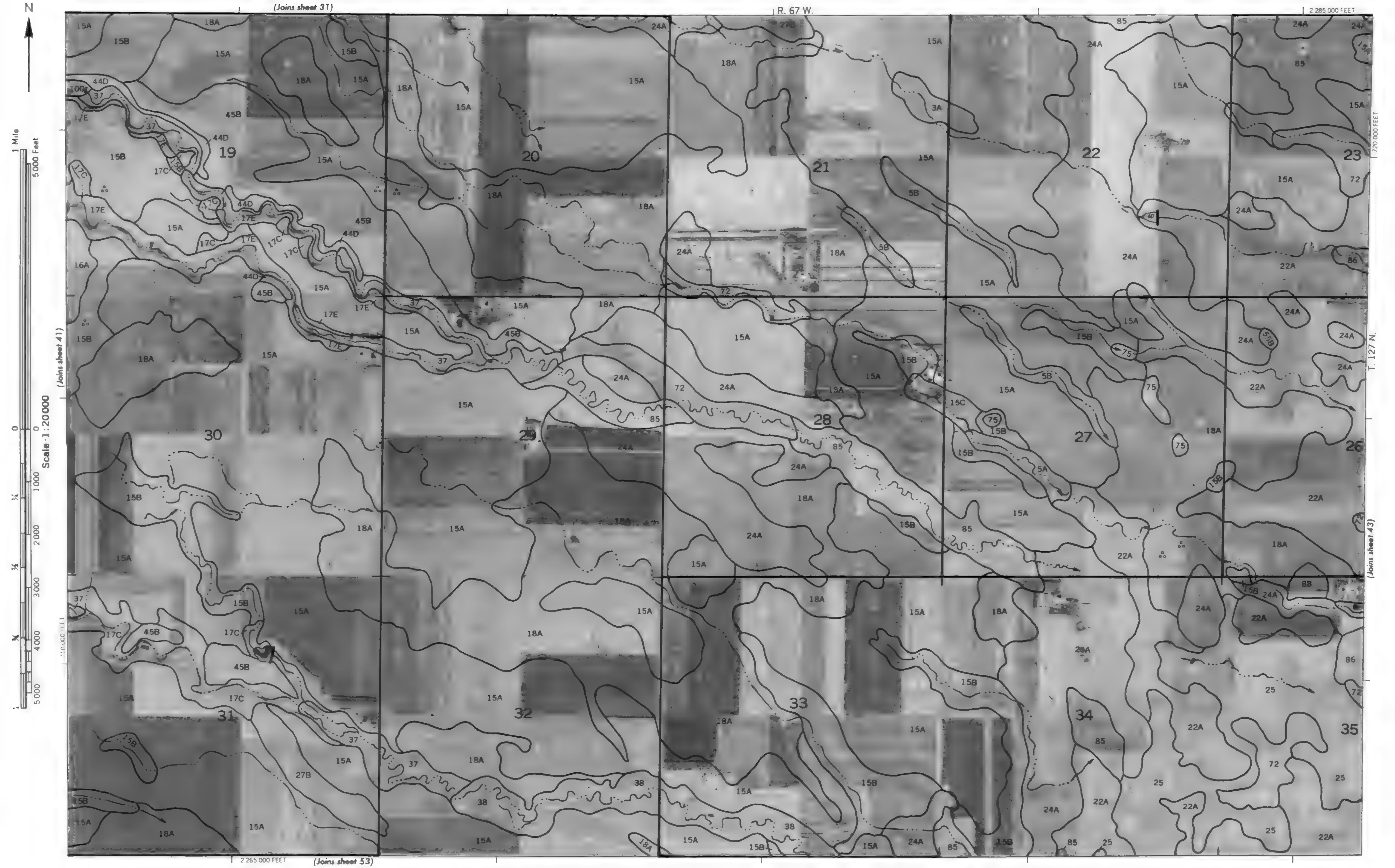

N
1 Mile
5000 Feet
0
Scale 1:20000
0
1000
2000
3000
4000
5000
(Joins sheet 29)
R. 69 W.
R. 68 W.
2 235 000 FEET
720 000 FEET
(Joins sheet 39)
T. 127 N.
(Joins sheet 41)
710 000 FEET
2 215 000 FEET
(Joins sheet 51)
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32

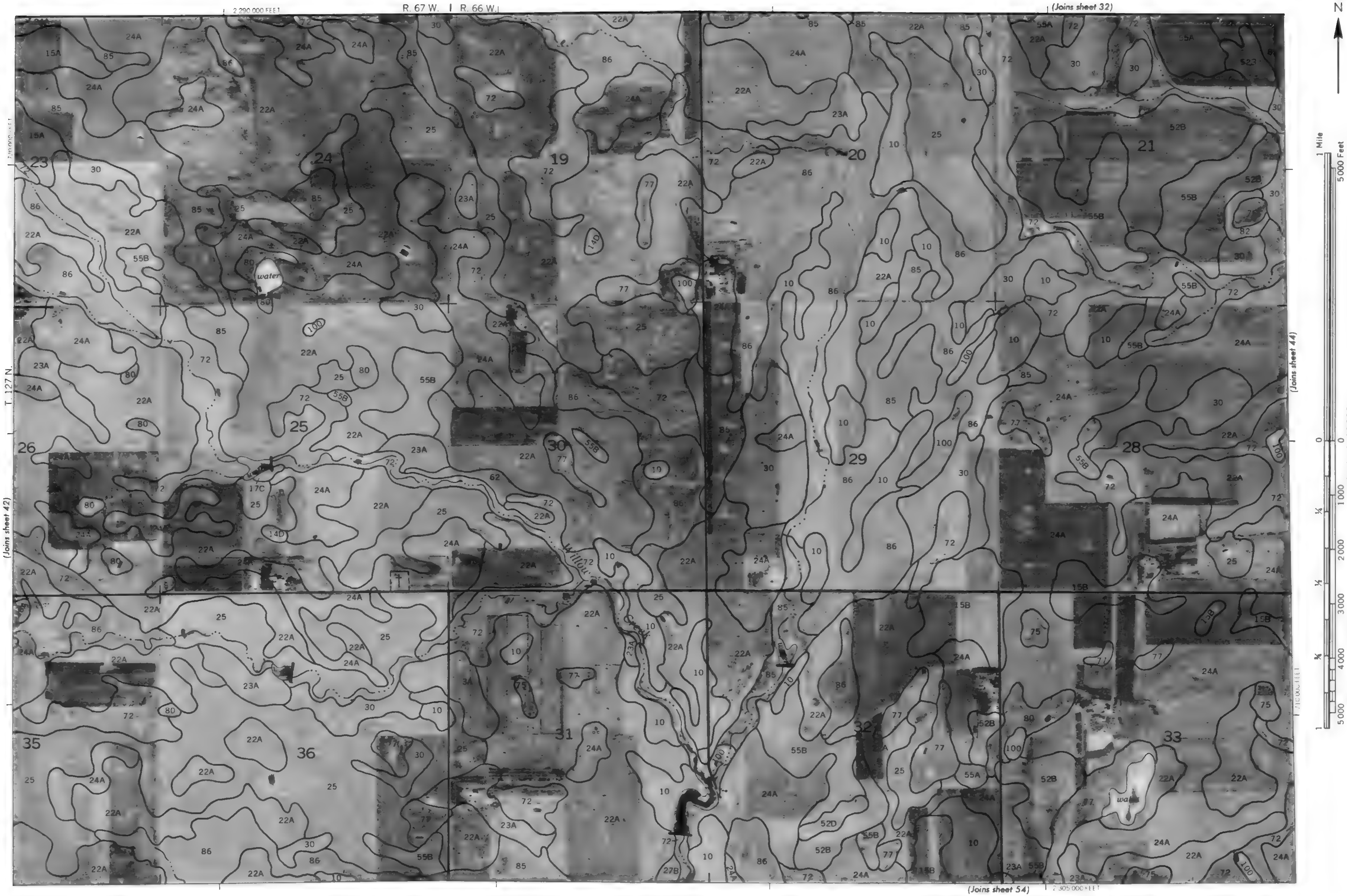
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 41

41

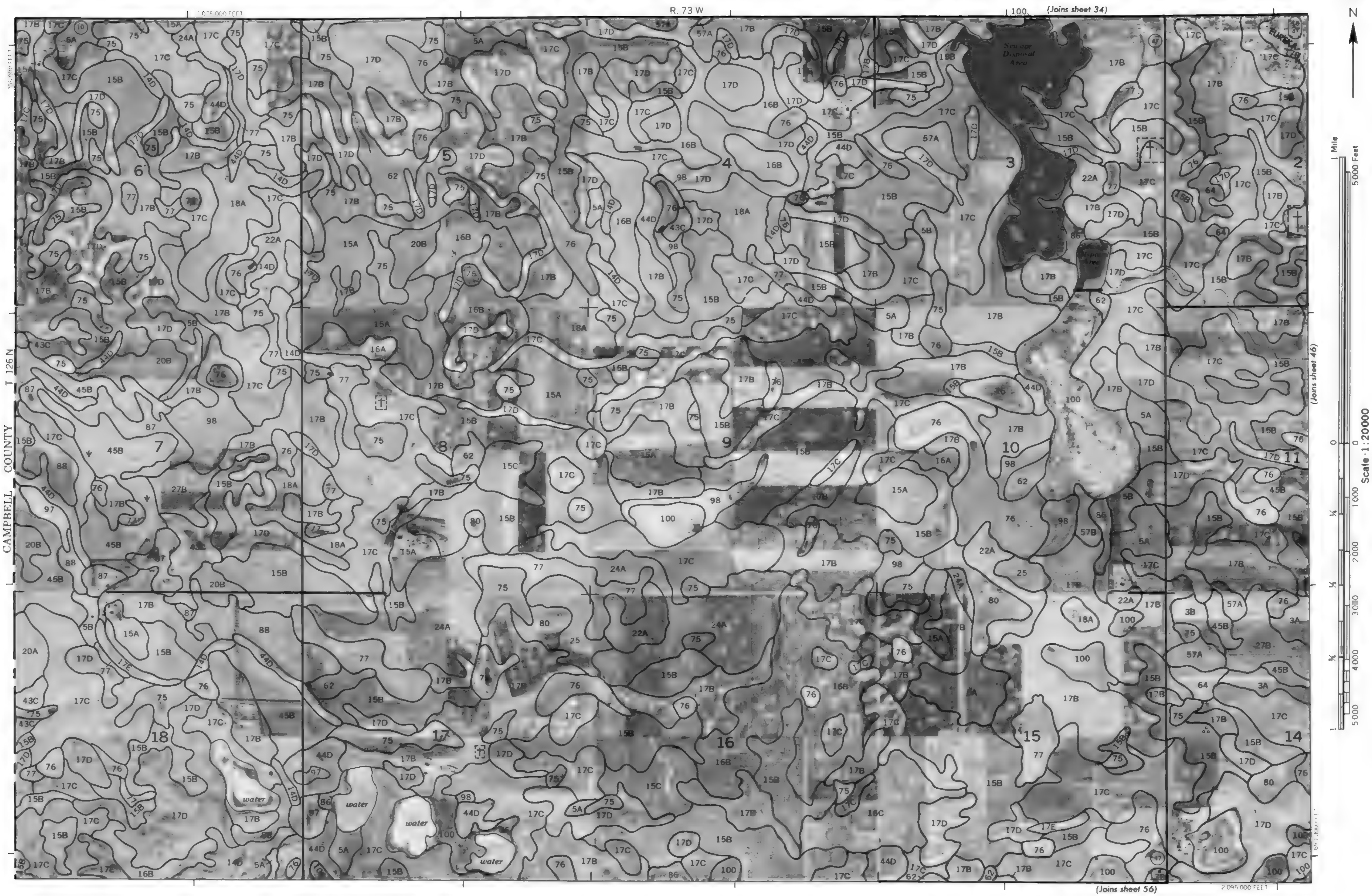


McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 42

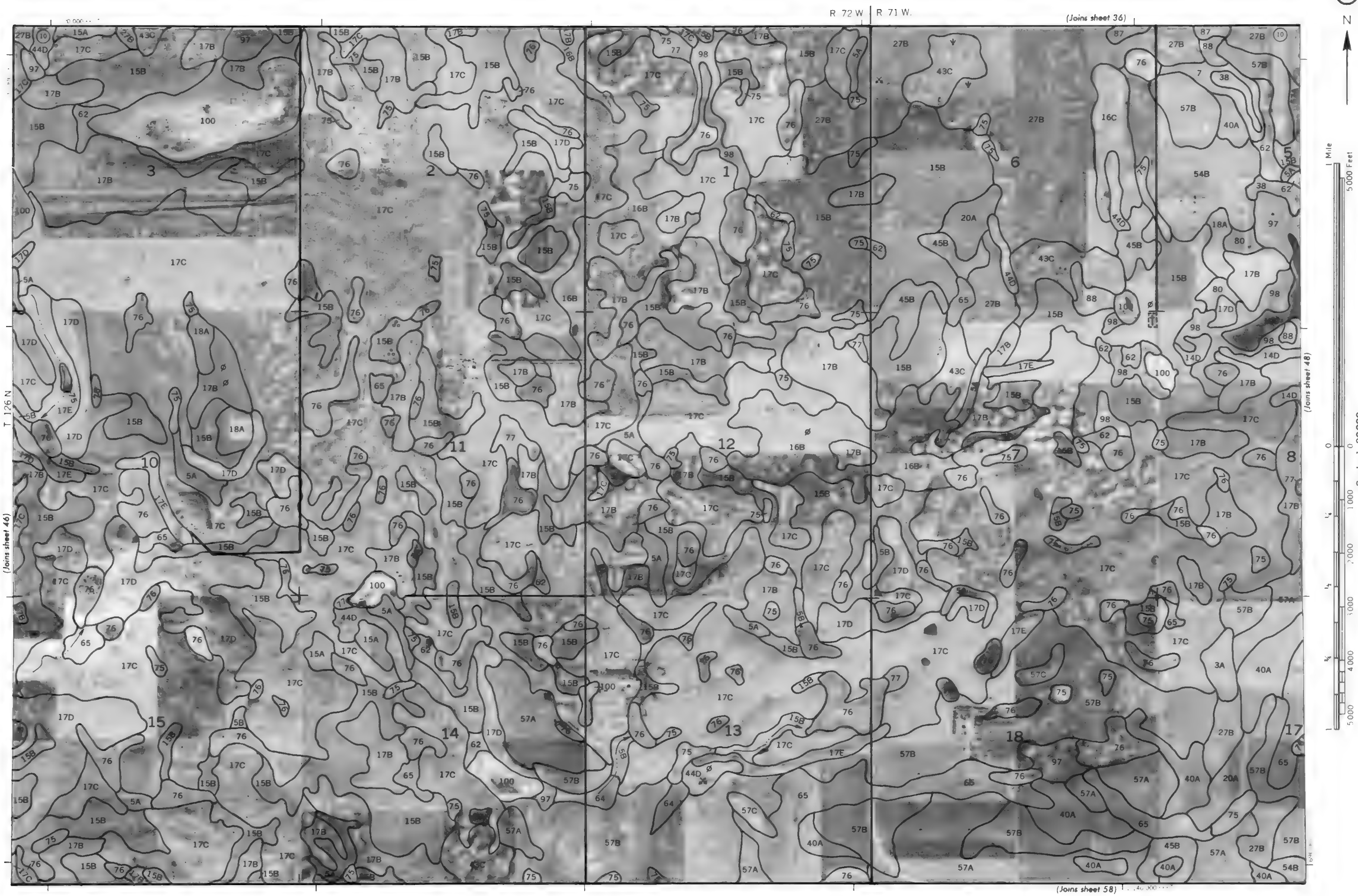



2 290 000 FEET
R. 67 W.
R. 66 W.
(Joins sheet 32)
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 54)
T. 127 N.
2 305 000 FEET
N
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
water
Willow
1 Mile
5000 Feet
Scale 1:20000

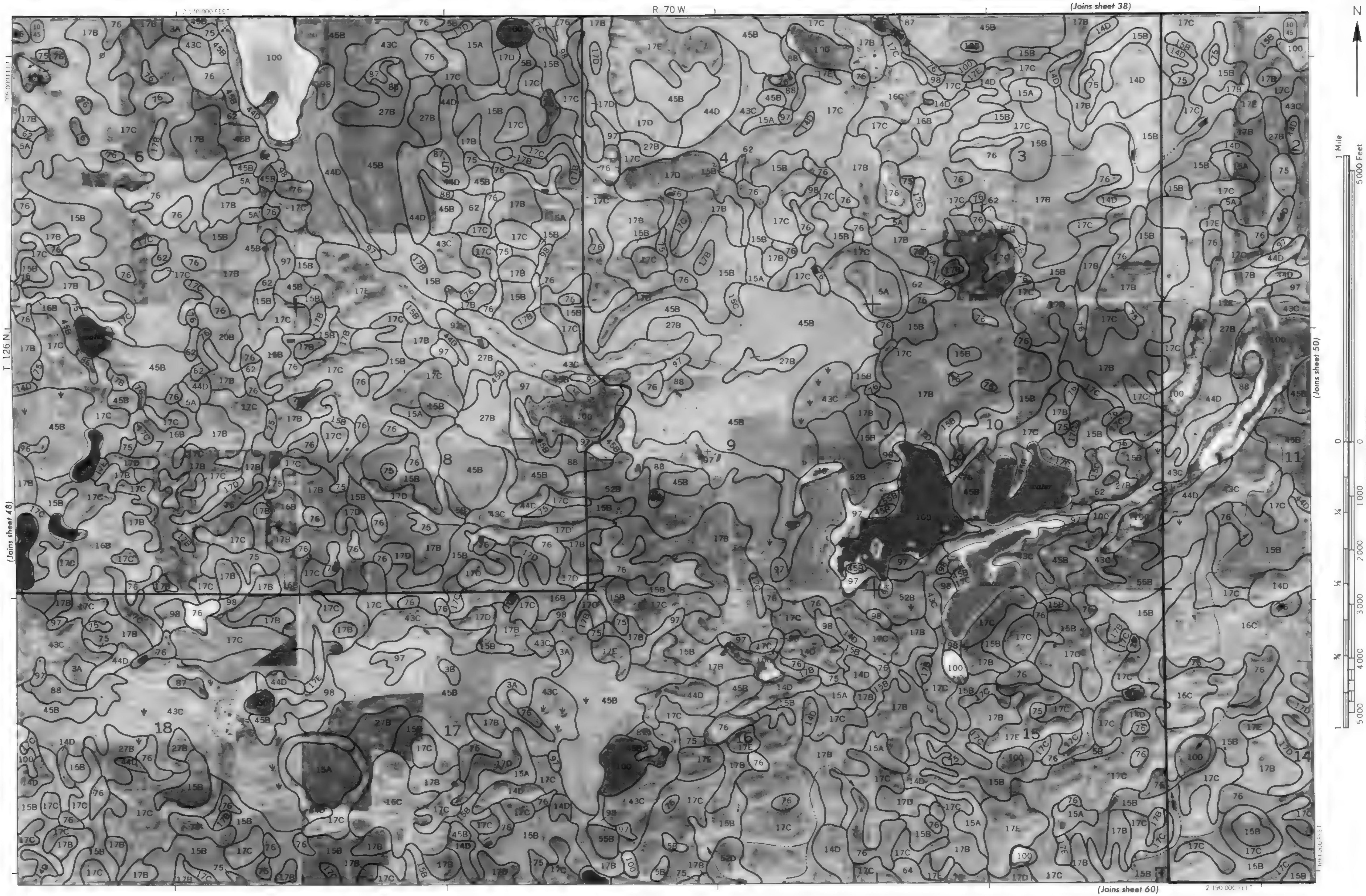

N
(Joins sheet 33)
R. 66 W.
2 330 000 FEET
720 000 FEET
T. 127 N.
(Joins sheet 43)
1 Mile
5000 Feet
Scale 1:20000
710 000 FEET
BROWN COUNTY
22
23
24
25
26
27
34
35
36
2 310 000 FEET
(Joins sheet 55)

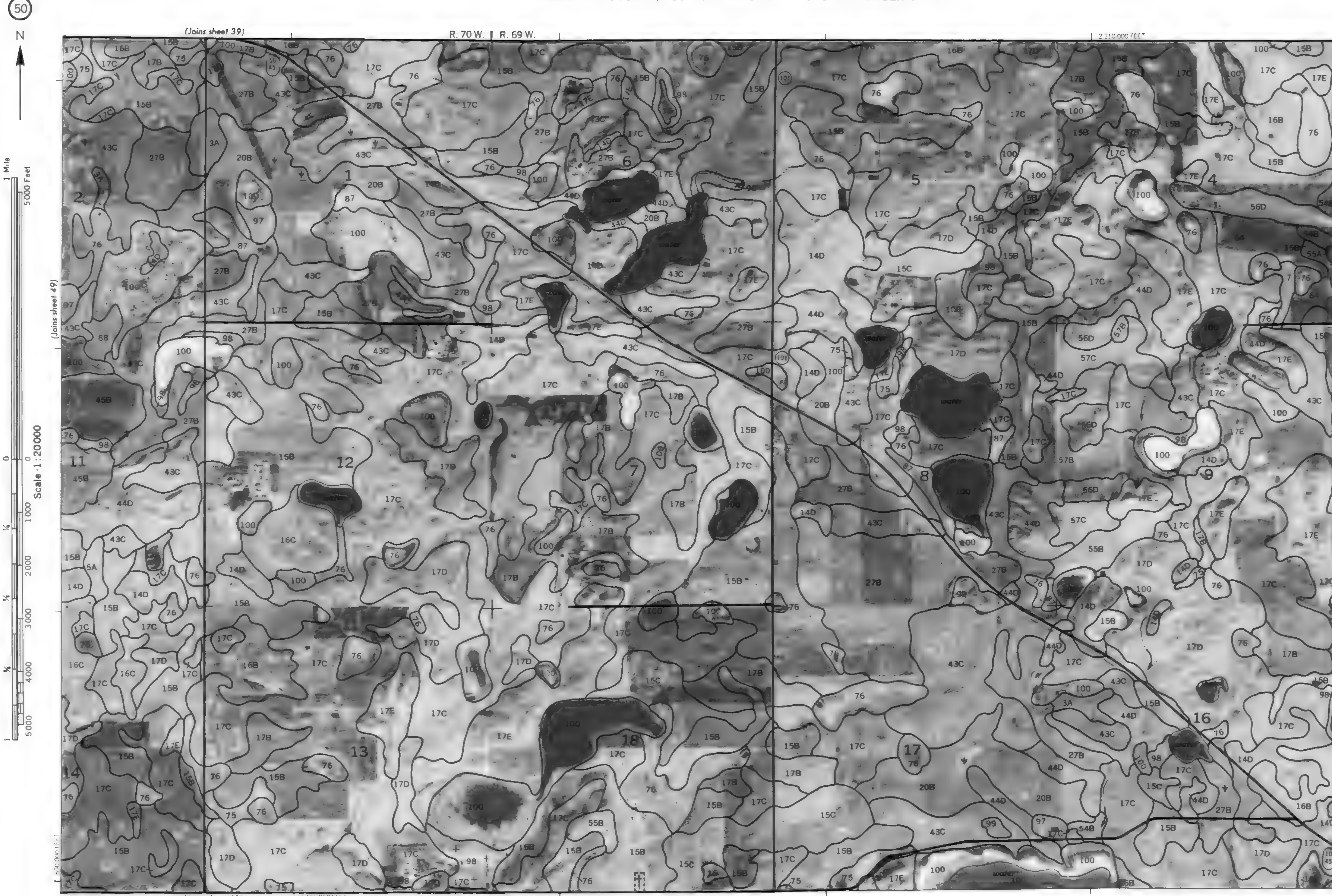

R. 73 W
(Joins sheet 34)
T 126 N
CAMPBELL COUNTY
(Joins sheet 46)
(Joins sheet 56)
Sewage Disposal Area
water
N
1 Mile
5000 Feet
Scale 1:20000
2 095 000 FEET

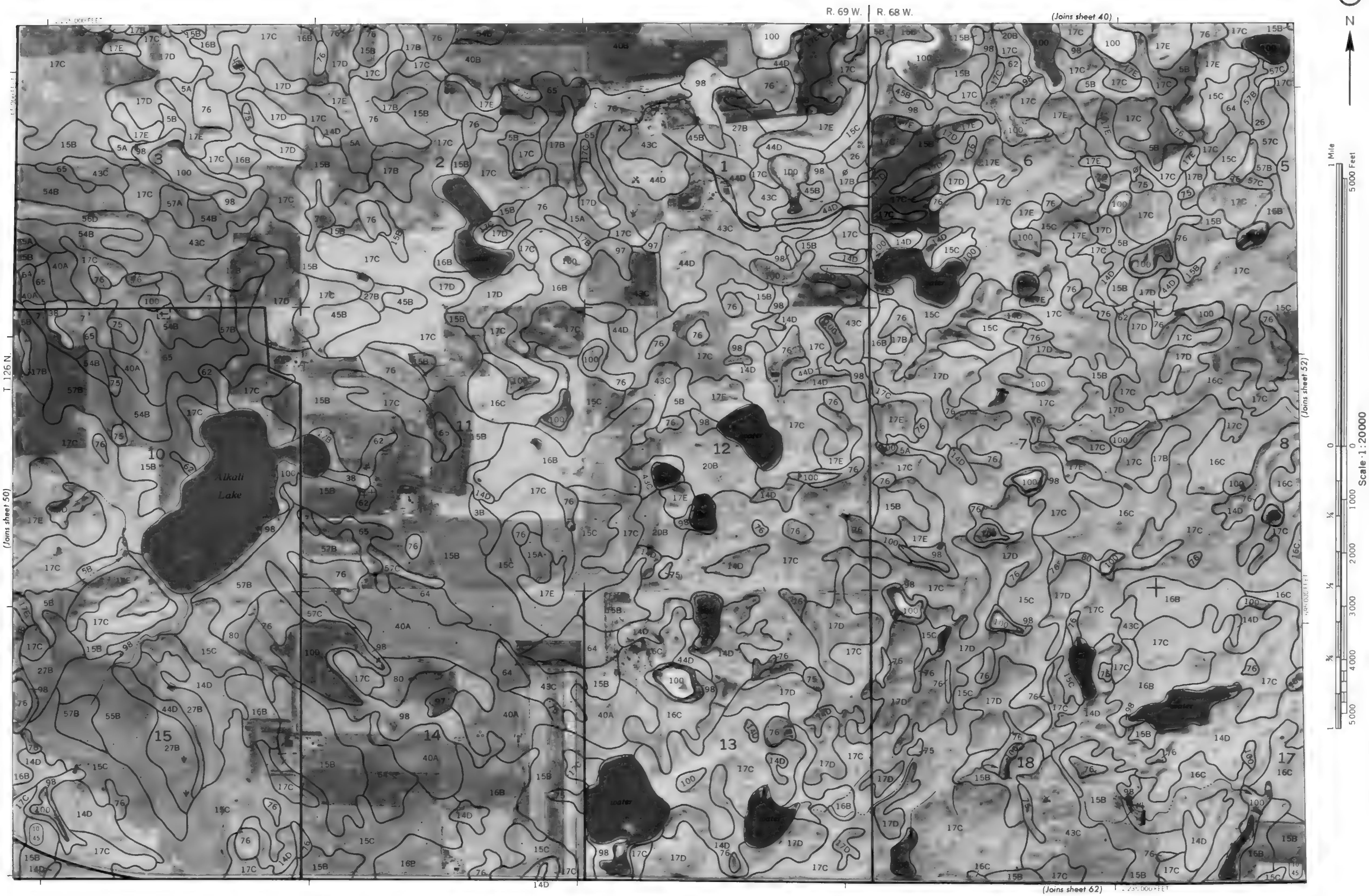

46
N
(Joins sheet 35)
R. 73 W.
R. 72 W.
2 115 000 FEET
EUREKA
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 57)
T. 126 N.
2 100 000 FEET
690 000 FEET
705 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000

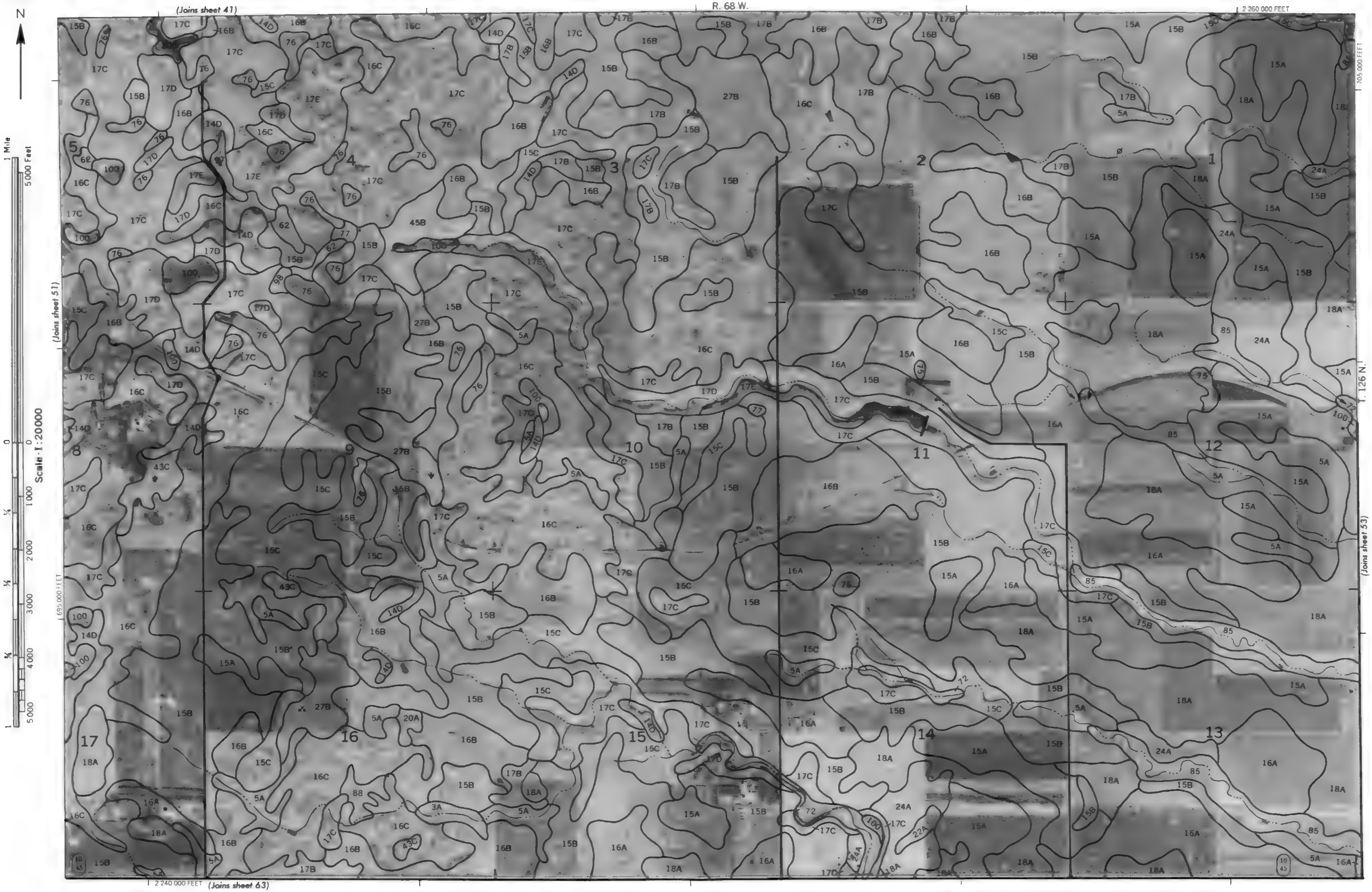

R. 72 W.
R. 71 W.
(Joins sheet 36)
(Joins sheet 48)
(Joins sheet 58)
(Joins sheet 46)
T. 126 N.
N
1 Mile
5000 Feet
Scale 1:20000

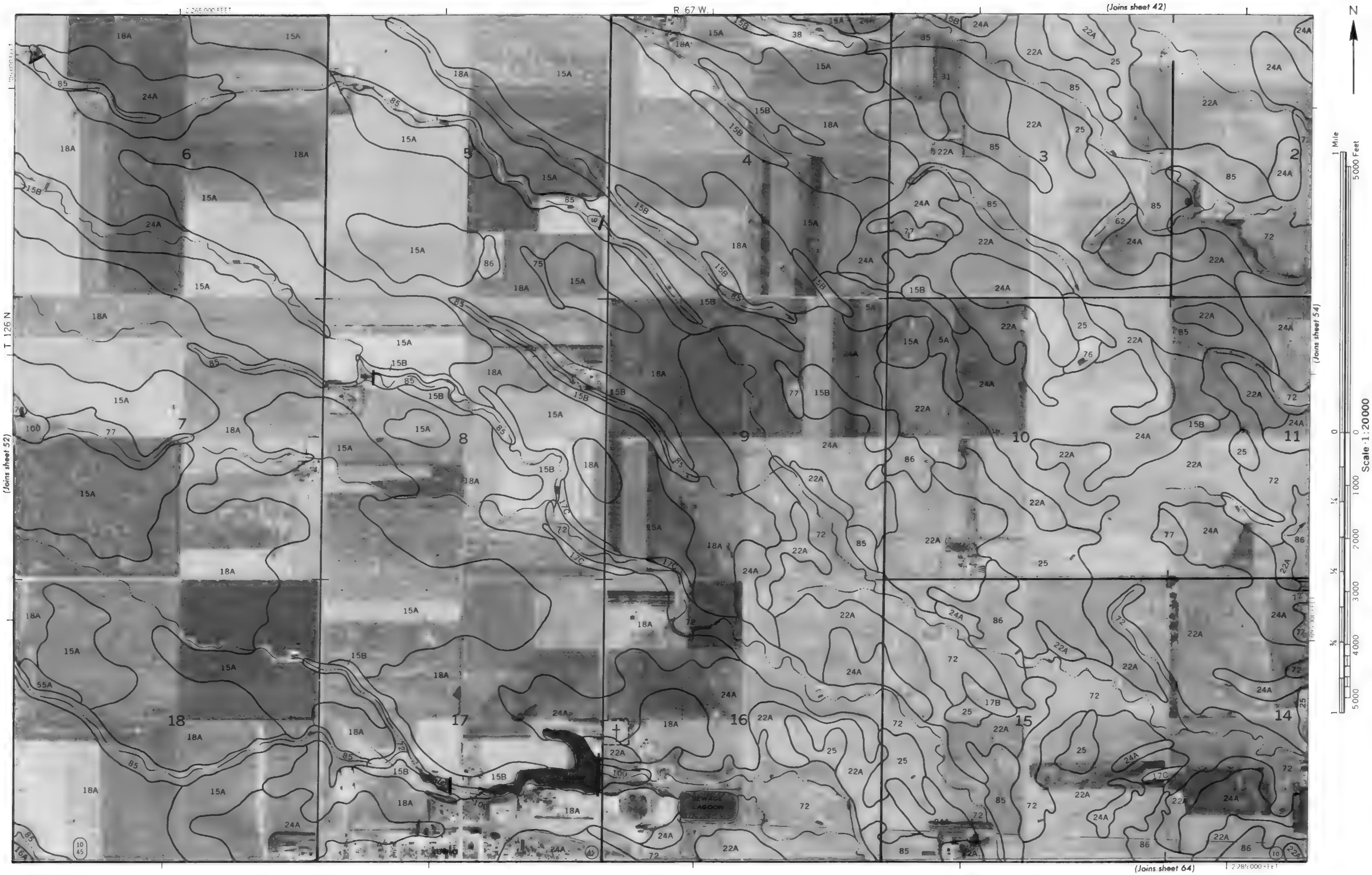

N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 37)
R. 71 W.
T. 126 N.
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 59)
2 165 000 FEET
2 145 000 FEET

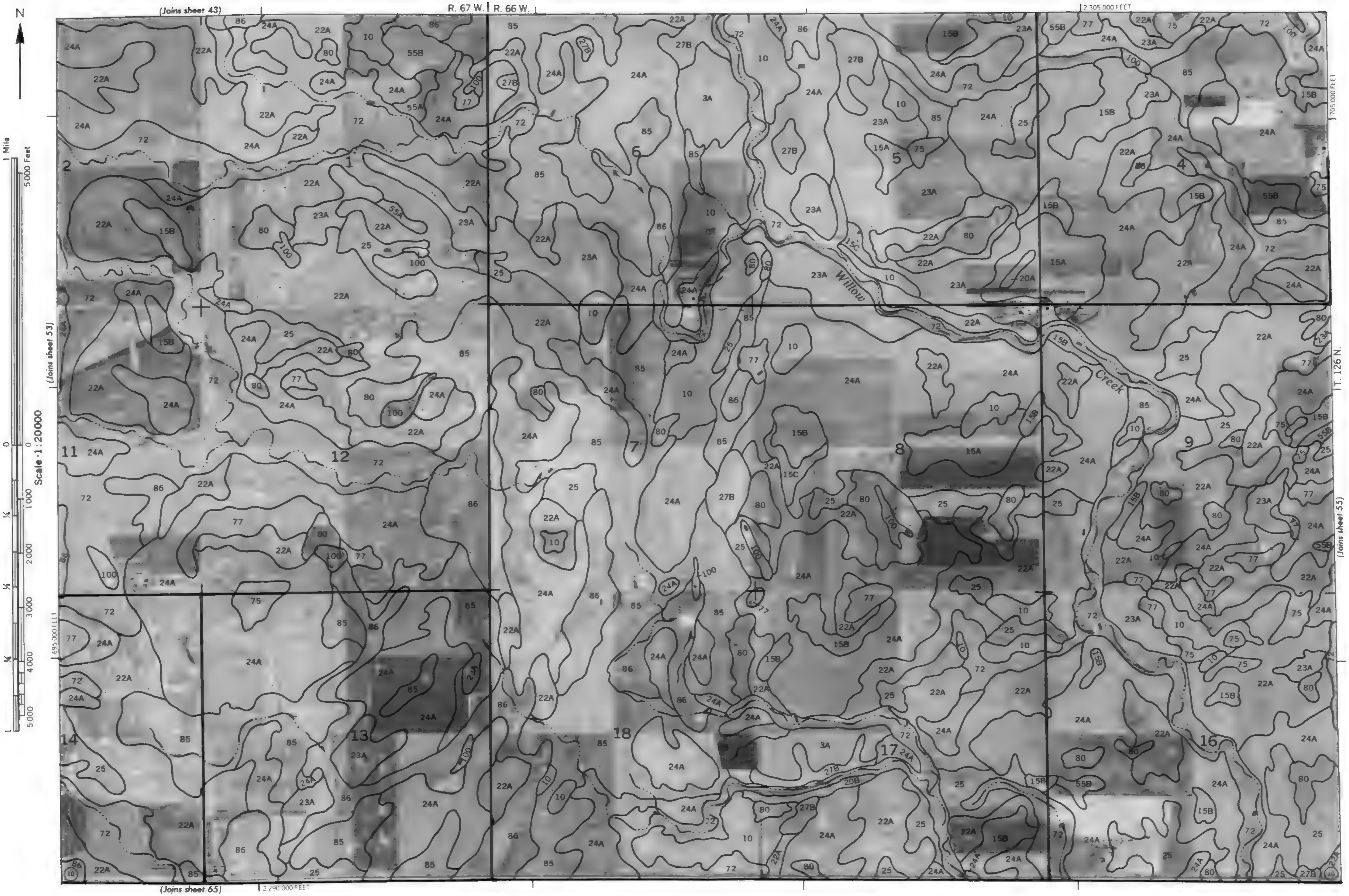

R. 70 W.
T. 126 N.
(Joins sheet 38)
(Joins sheet 50)
(Joins sheet 48)
(Joins sheet 60)
N
1 Mile
5000 Feet
Scale 1:20000

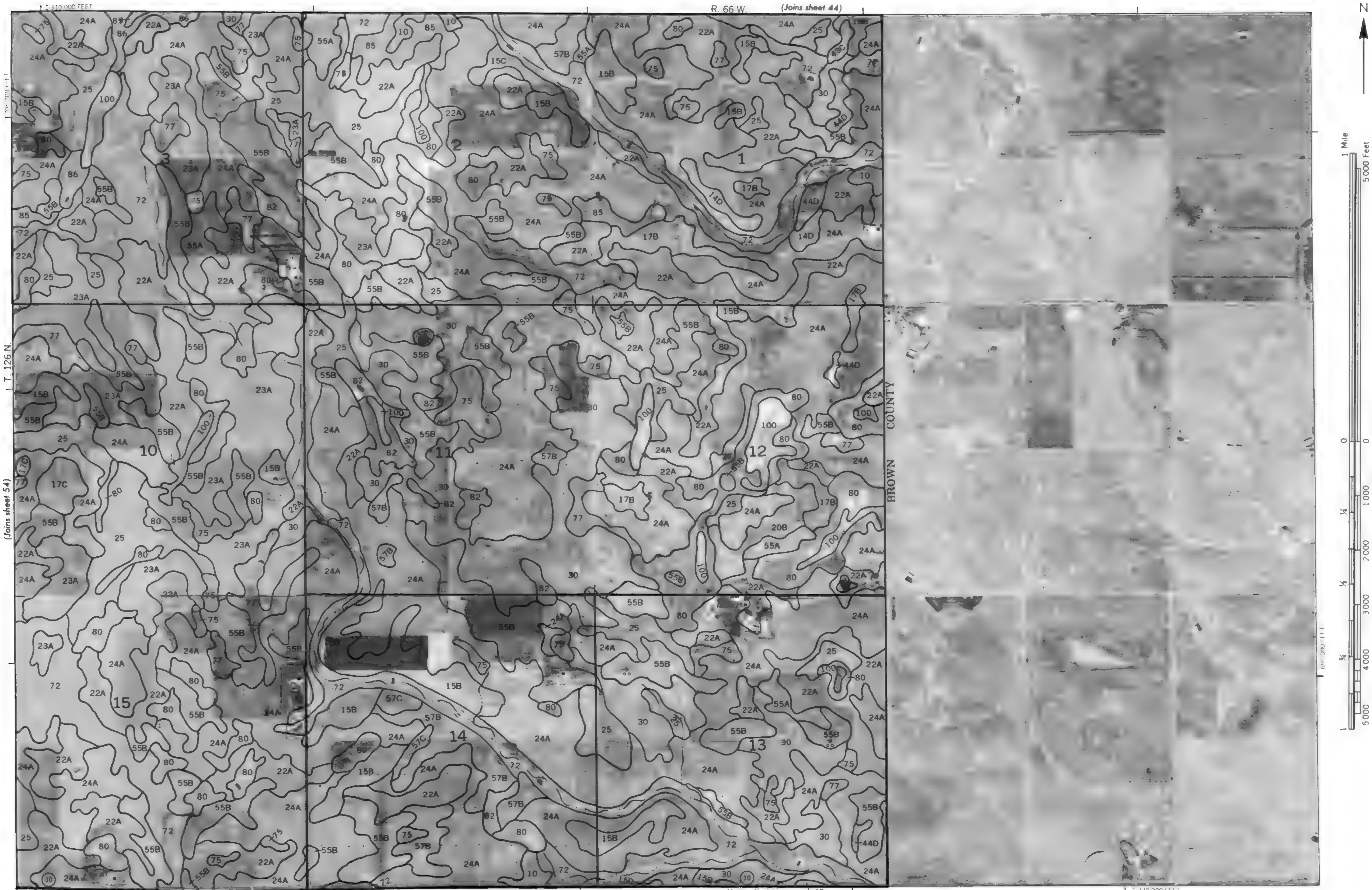

50
N
(Joins sheet 39)
R. 70 W.
R. 69 W.
2 210 000 FEET
705 000 FEET
(Joins sheet 49)
(Joins sheet 51)
T. 126 N.
(Joins sheet 61)
2 195 000 FEET
690 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
½
¼
¾
water

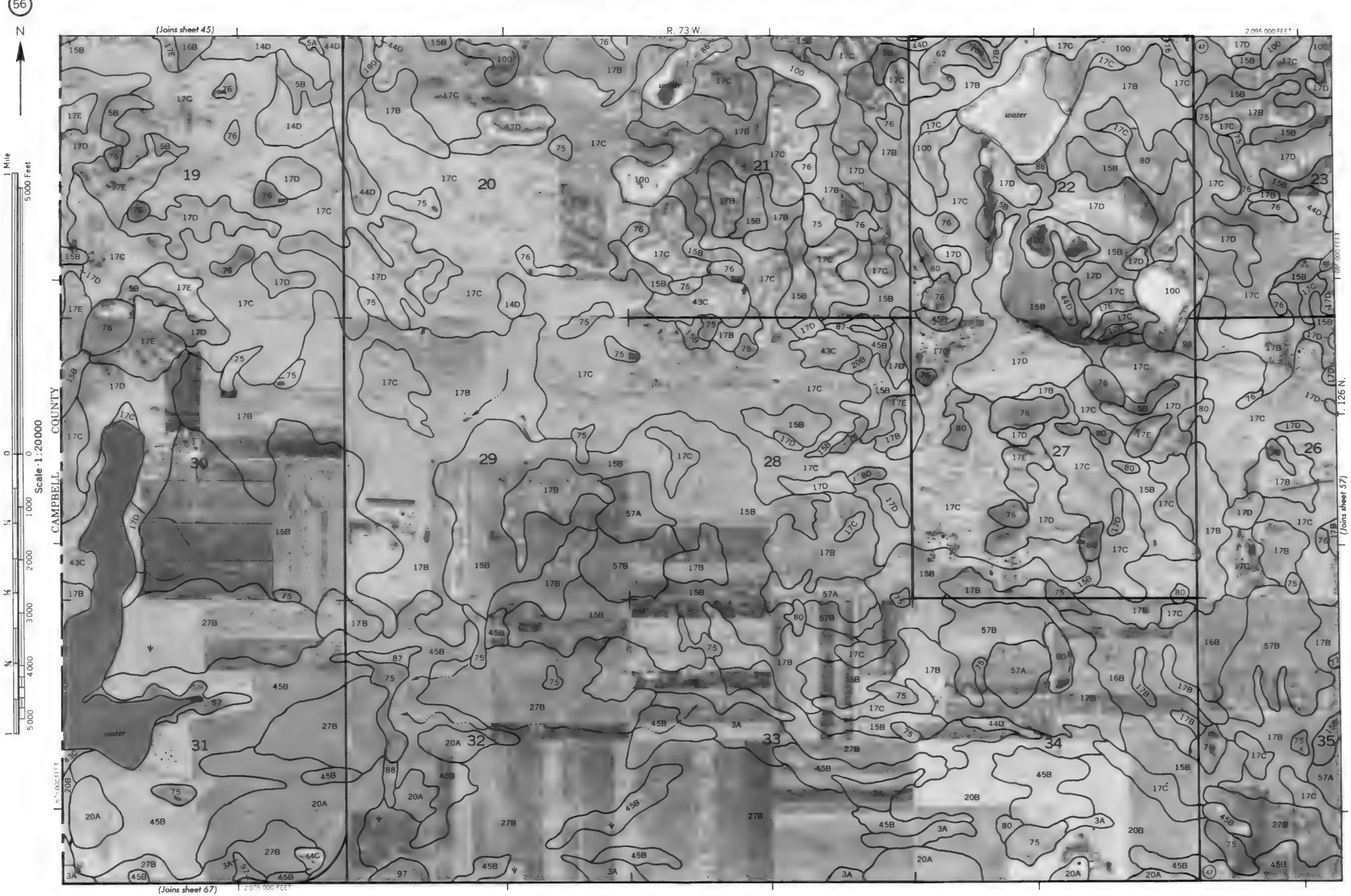

R. 69 W.
R. 68 W.
(Joins sheet 40)
(Joins sheet 52)
(Joins sheet 62)
(Joins sheet 50)
T. 126 N.
Alkali Lake
N
1 Mile
5000 Feet
Scale 1:20000

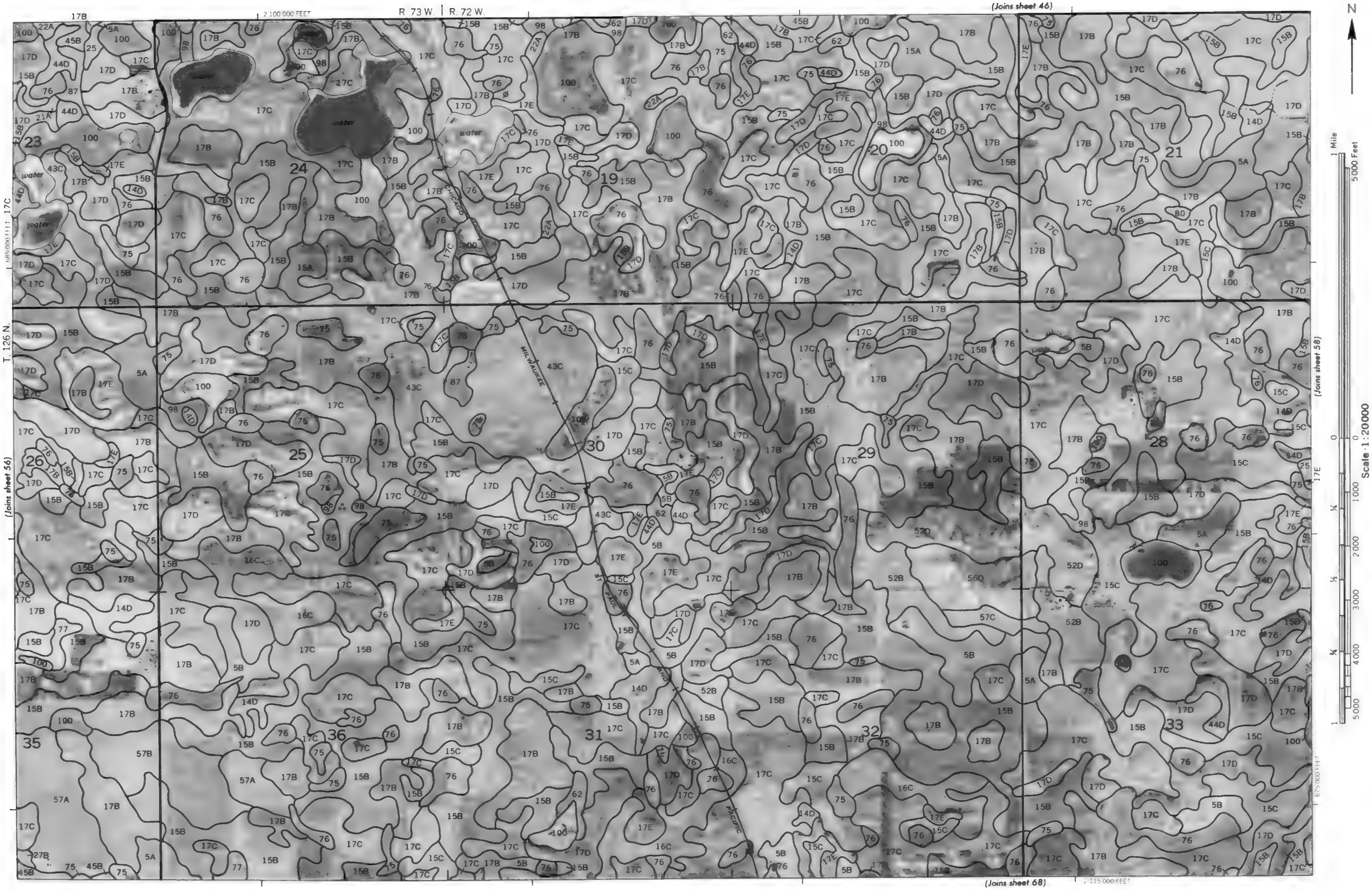

N
(Joins sheet 41)
R. 68 W.
2 260 000 FEET
705 000 FEET
(Joins sheet 51)
T. 126 N.
(Joins sheet 53)
695 000 FEET
2 240 000 FEET
(Joins sheet 63)
Scale 1:20000
1 Mile
5 000 Feet
0
1000
2000
3000
4000
5000


53
N
(Joins sheet 42)
(Joins sheet 52)
(Joins sheet 54)
(Joins sheet 64)
R. 67 W.
T. 126 N.
2 265 000 FEET
2 285 000 FEET
1 Mile
5000 Feet
Scale 1:20000
SEWAGE LAGOON
6
5
4
3
2
7
8
9
10
11
18
17
16
15
14

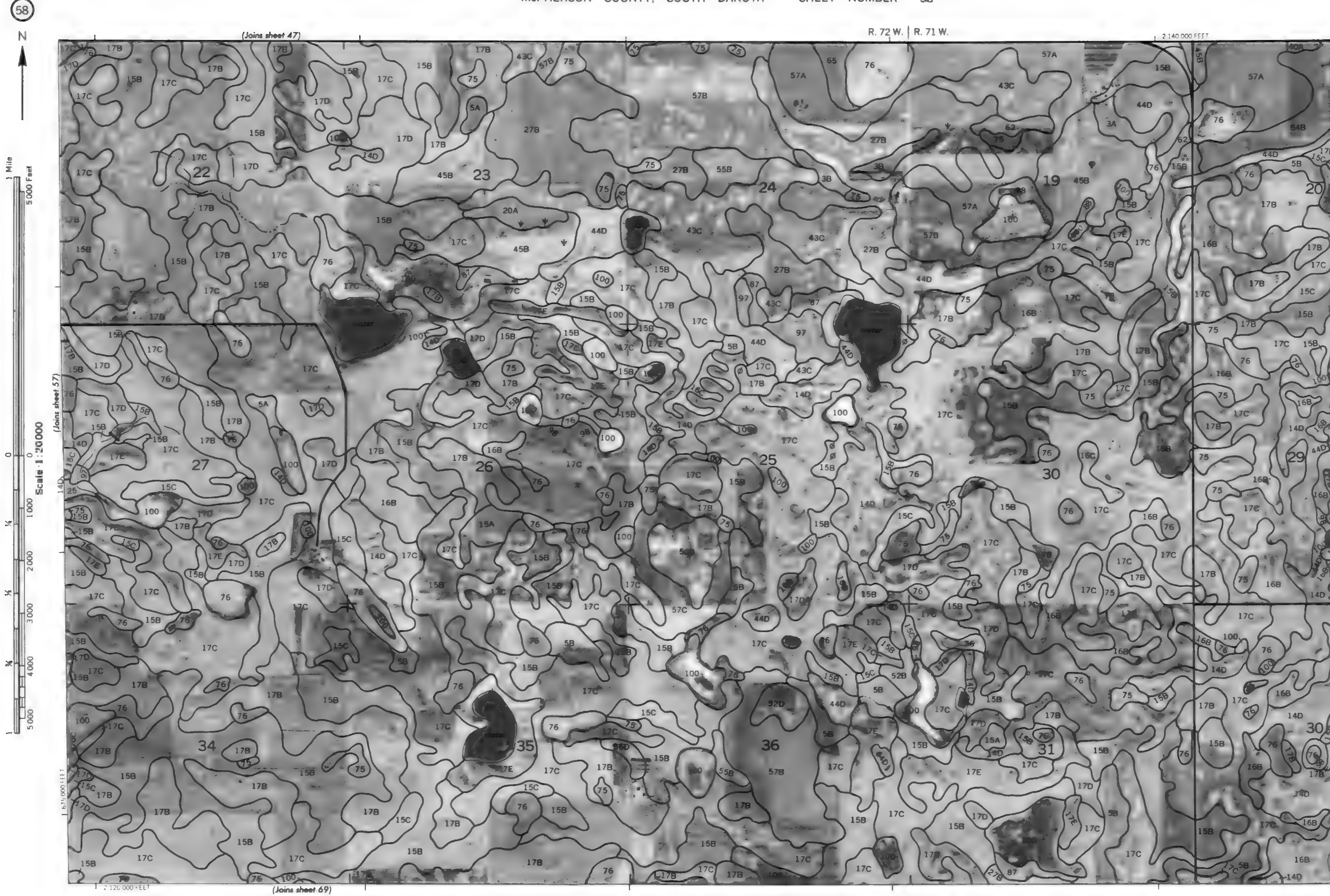

N
(Joins sheet 43)
R. 67 W.
R. 66 W.
2 305 000 FEET
705 000 FEET
(Joins sheet 53)
(Joins sheet 55)
T. 126 N.
695 000 FEET
(Joins sheet 65)
2 290 000 FEET
1 Mile
5000 Feet
Scale 1:20000
Willow
Creek

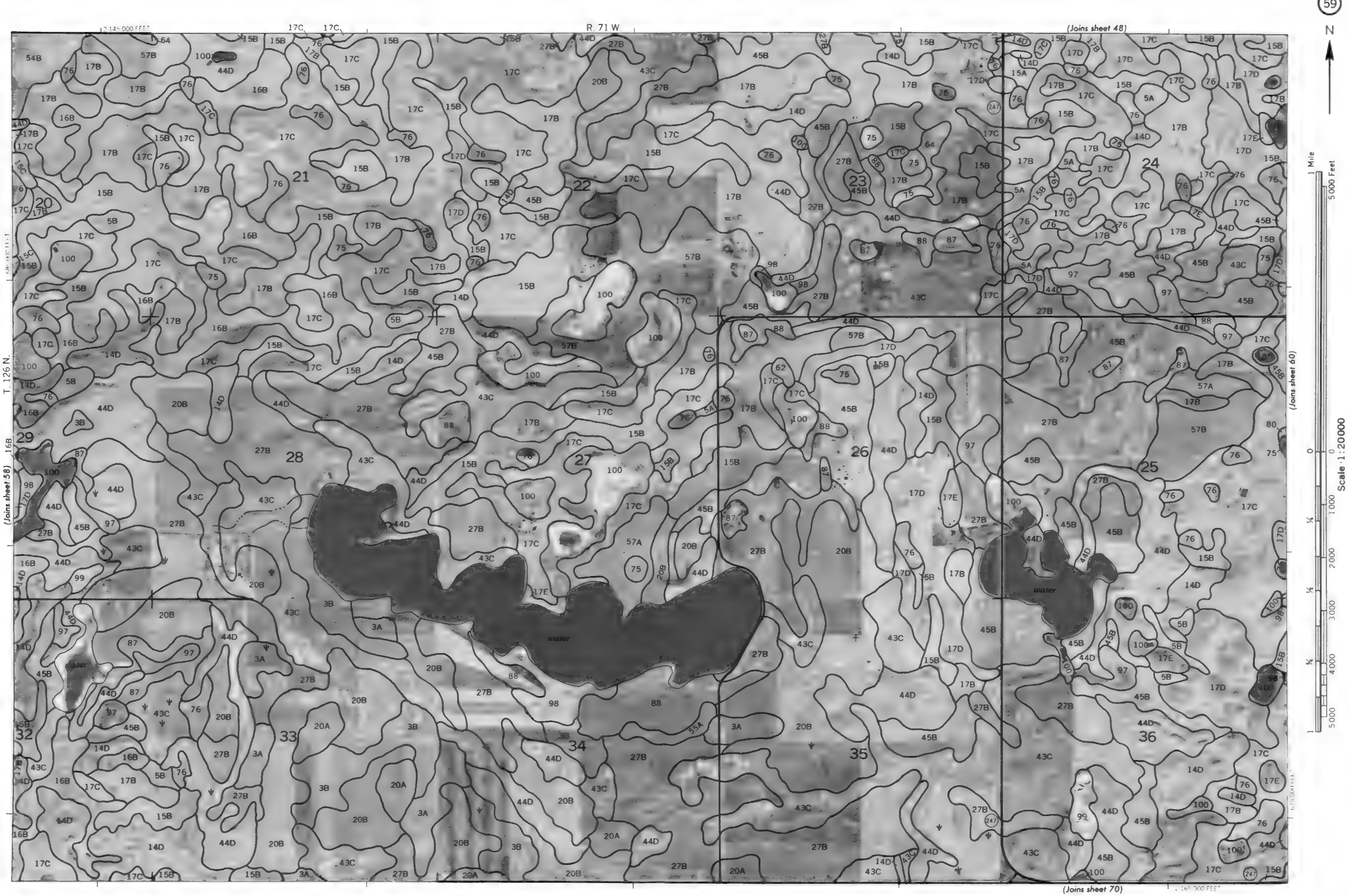

2 310 000 FEET
R. 66 W.
(Joins sheet 44)
T. 126 N.
(Joins sheet 54)
(Joins sheet 56)
BROWN COUNTY
1
2
3
10
11
12
13
14
15
2 330 000 FEET
N
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
Scale 1:20000

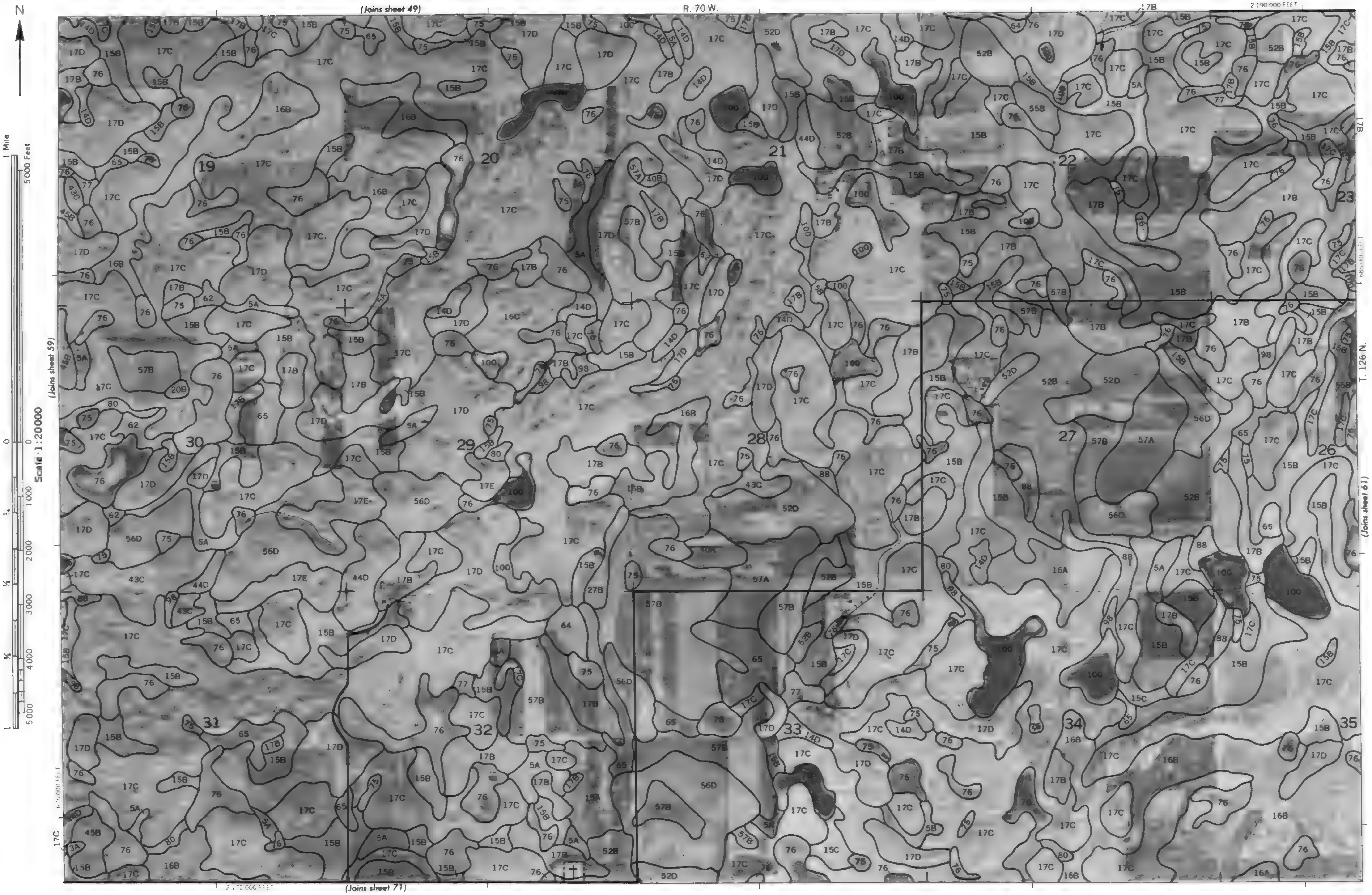

N
(Joins sheet 45)
R. 73 W.
2 095 000 FEET
T. 126 N.
(Joins sheet 57)
(Joins sheet 67)
2 075 000 FEET
CAMPBELL COUNTY
Scale 1:20000
1 Mile
5000 Feet
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
water

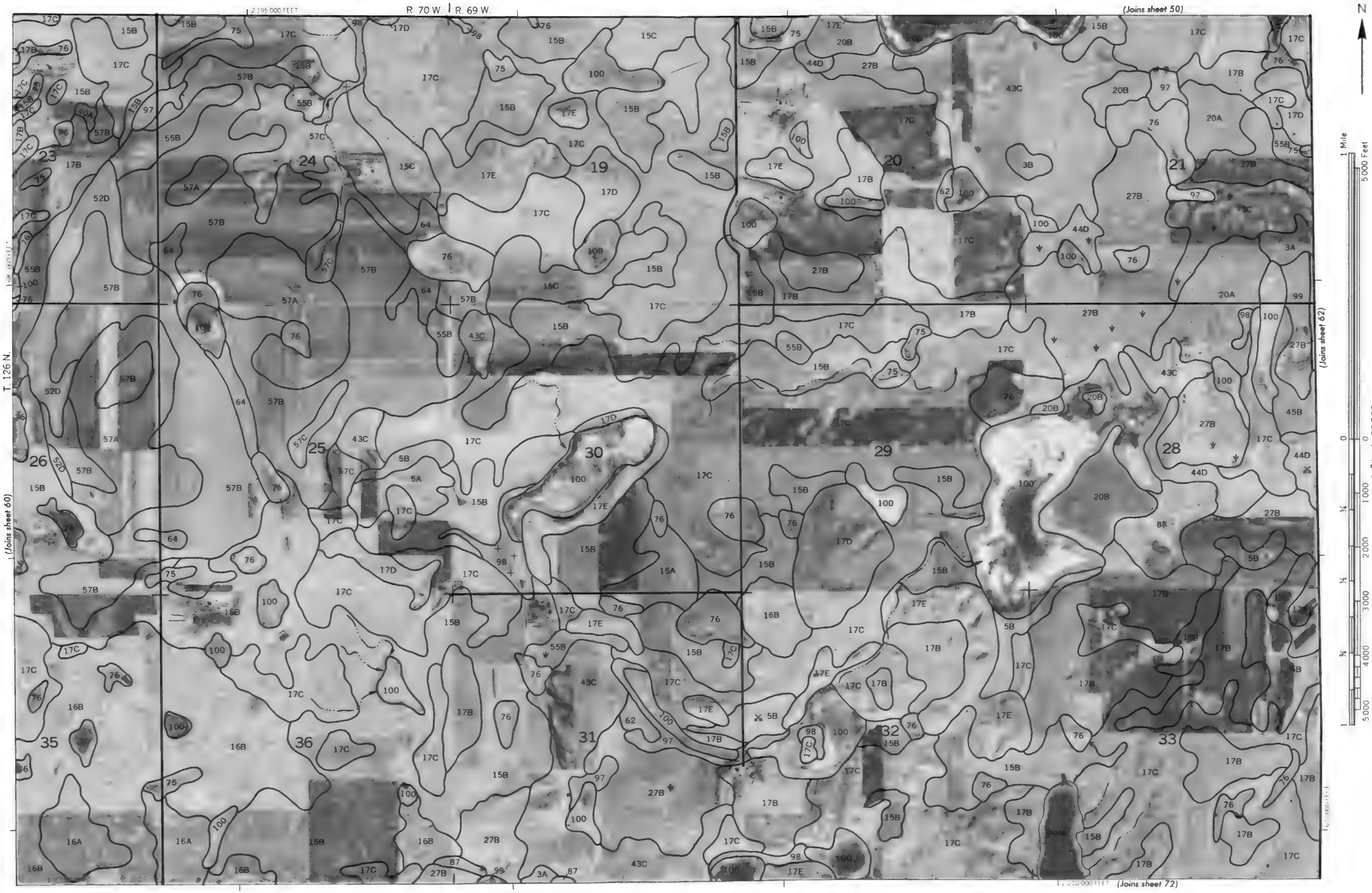


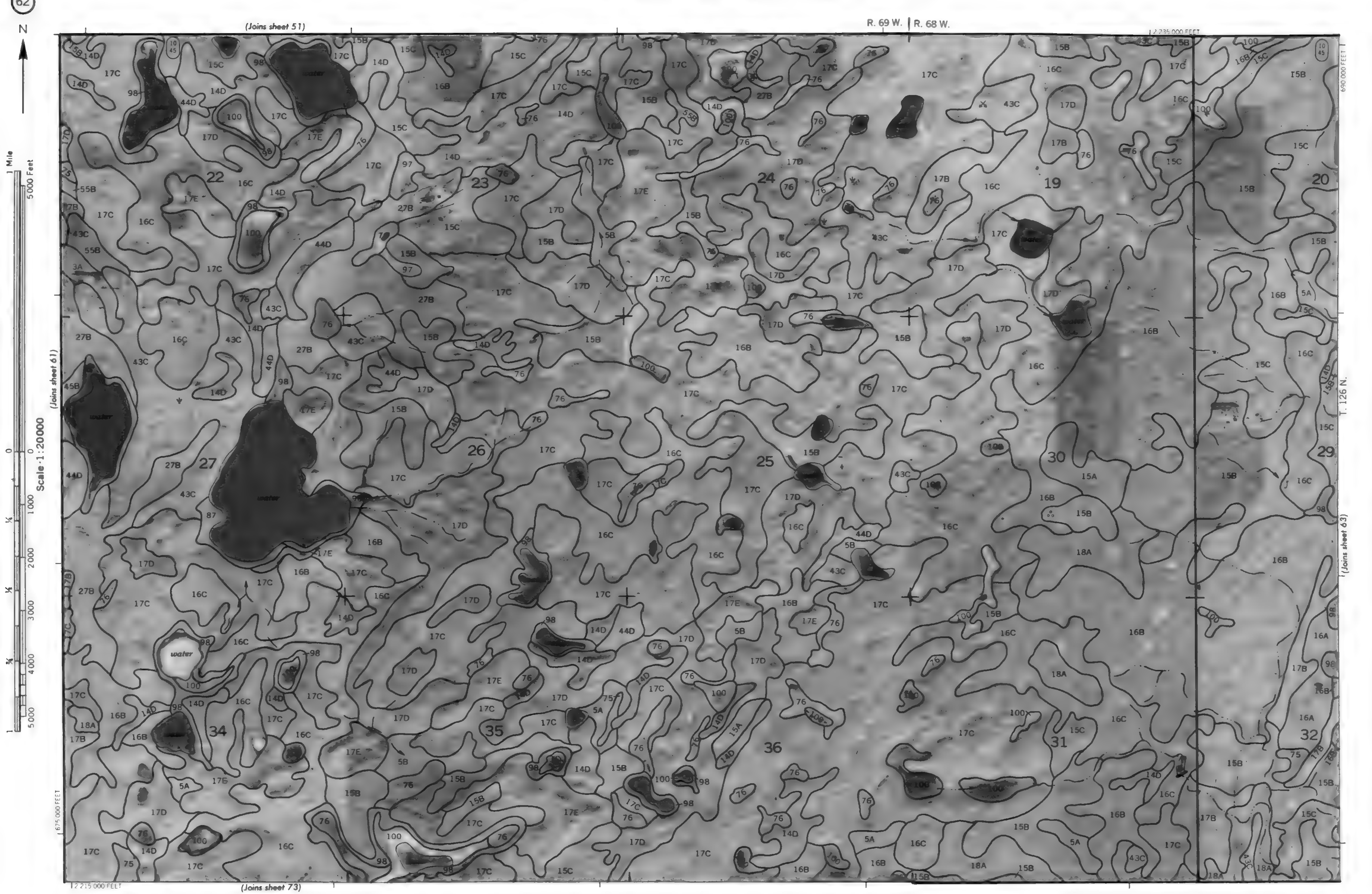
(Joins sheet 46)
(Joins sheet 68)
(Joins sheet 56)
(Joins sheet 58)
R. 73 W.
R. 72 W.
T. 126 N.
2 100 000 FEET
685 000 FEET
675 000 FEET
2 115 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
water
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

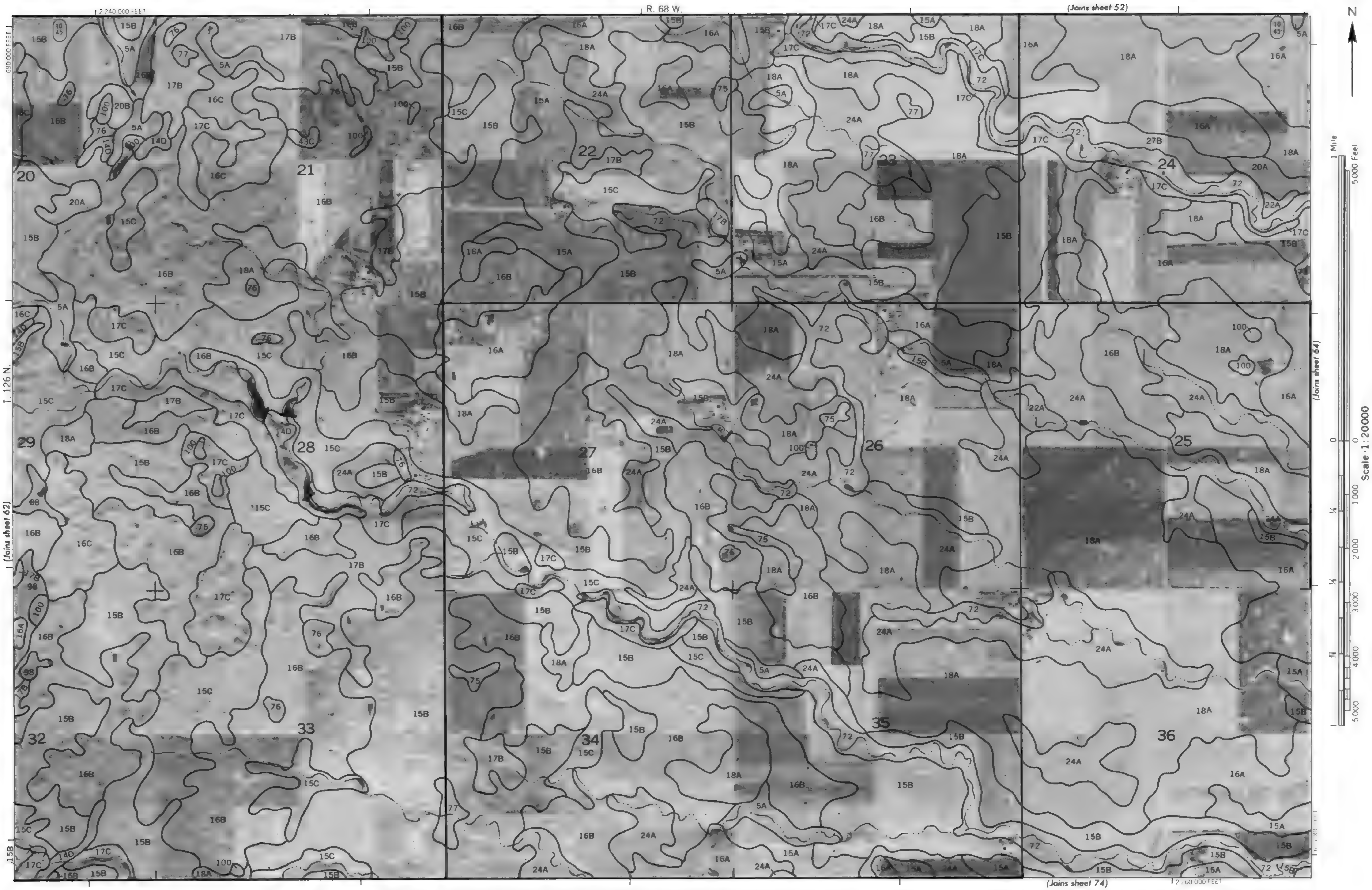

58
N
1 Mile
5000 Feet
0
Scale 1:20000
1000
2000
3000
4000
5000
(Joins sheet 47)
R. 72 W. | R. 71 W.
2 140 000 FEET
T. 126 N.
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 69)
2 120 000 FEET
675 000 FEET
22
23
24
19
20
27
26
25
30
29
34
35
36
31
30
water

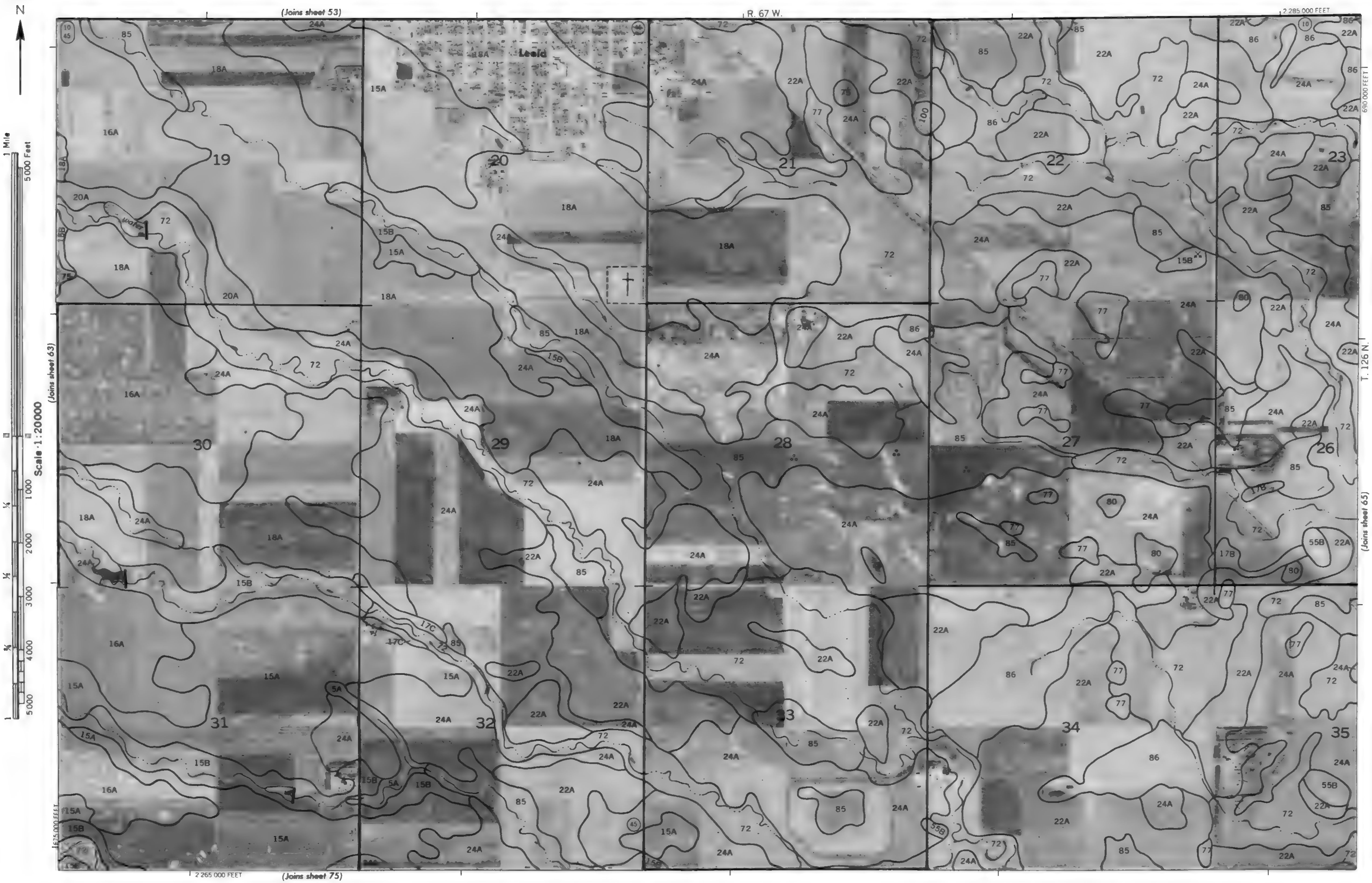

59
N
R. 71 W.
(Joins sheet 48)
(Joins sheet 58)
(Joins sheet 60)
(Joins sheet 70)
T. 126 N.
water
1 Mile
5000 Feet
Scale 1:20000


N
1 Mile
5000 Feet
Scale 1:20 000
(Joins sheet 49)
R. 70 W.
2 190 000 FEET
(Joins sheet 59)
T. 126 N.
(Joins sheet 61)
(Joins sheet 71)
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

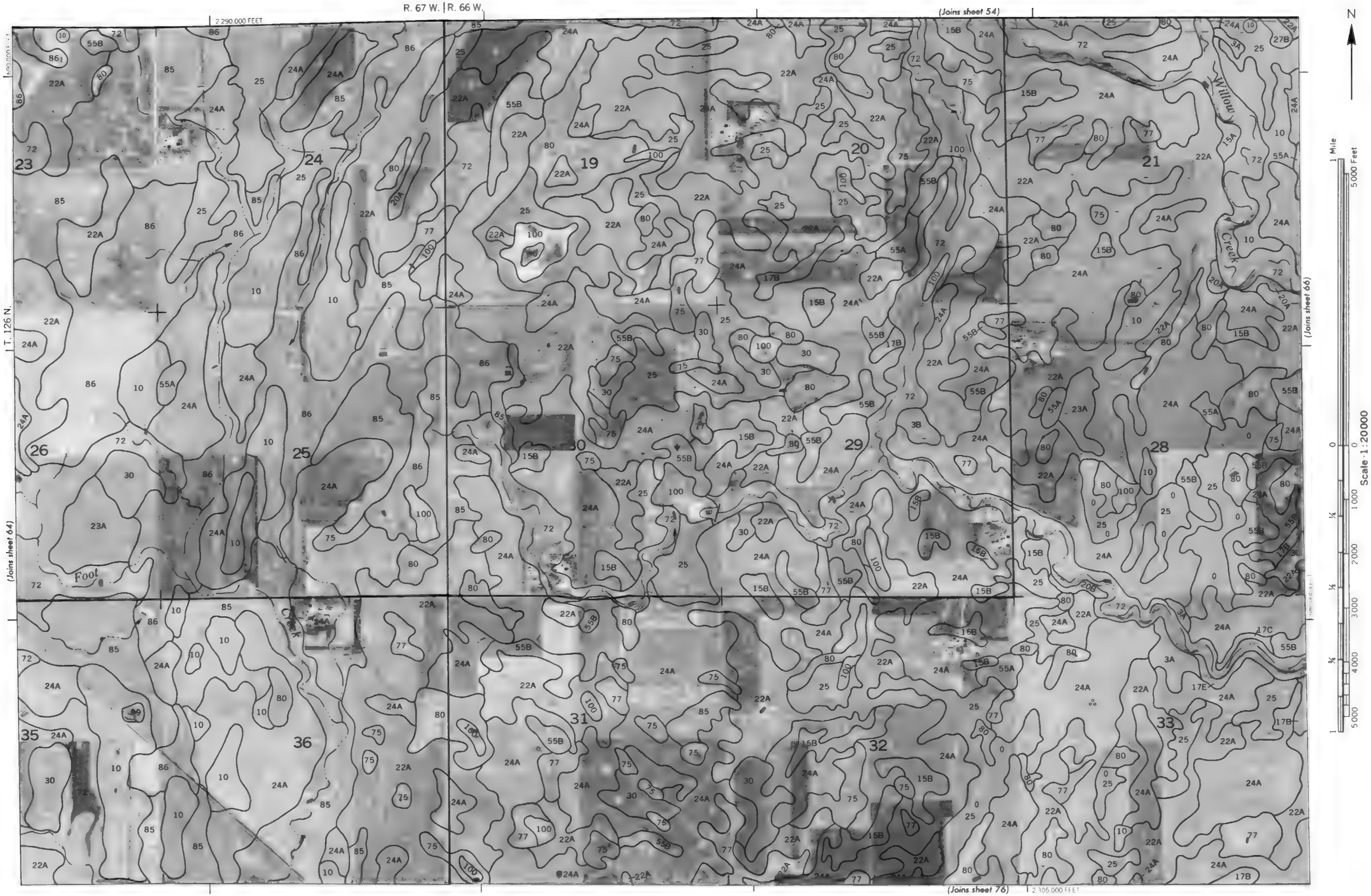

N
R. 70 W.
R. 69 W.
2 195 000 FEET
(Joins sheet 50)
(Joins sheet 62)
(Joins sheet 72)
(Joins sheet 60)
T. 126 N.
1 Mile
5000 Feet
Scale 1:20 000
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36


(Joins sheet 51)
R. 69 W. | R. 68 W.
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 73)
T. 126 N.
N
1 Mile
5000 Feet
Scale 1:20000
2 235 000 FEET
690 000 FEET
675 000 FEET
2 215 000 FEET
water
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32


2 240 000 FEET
690 000 FEET
R. 68 W.
(Joins sheet 52)
(Joins sheet 64)
(Joins sheet 62)
(Joins sheet 74)
2 260 000 FEET
T. 126 N.
N
1 Mile
5000 Feet
Scale 1:20000
20
21
22
23
24
29
28
27
26
25
32
33
34
35
36


N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 53)
(Joins sheet 63)
(Joins sheet 65)
(Joins sheet 75)
R. 67 W.
T. 126 N.
2 285 000 FEET
690 000 FEET
2 265 000 FEET
675 000 FEET
Leola
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35

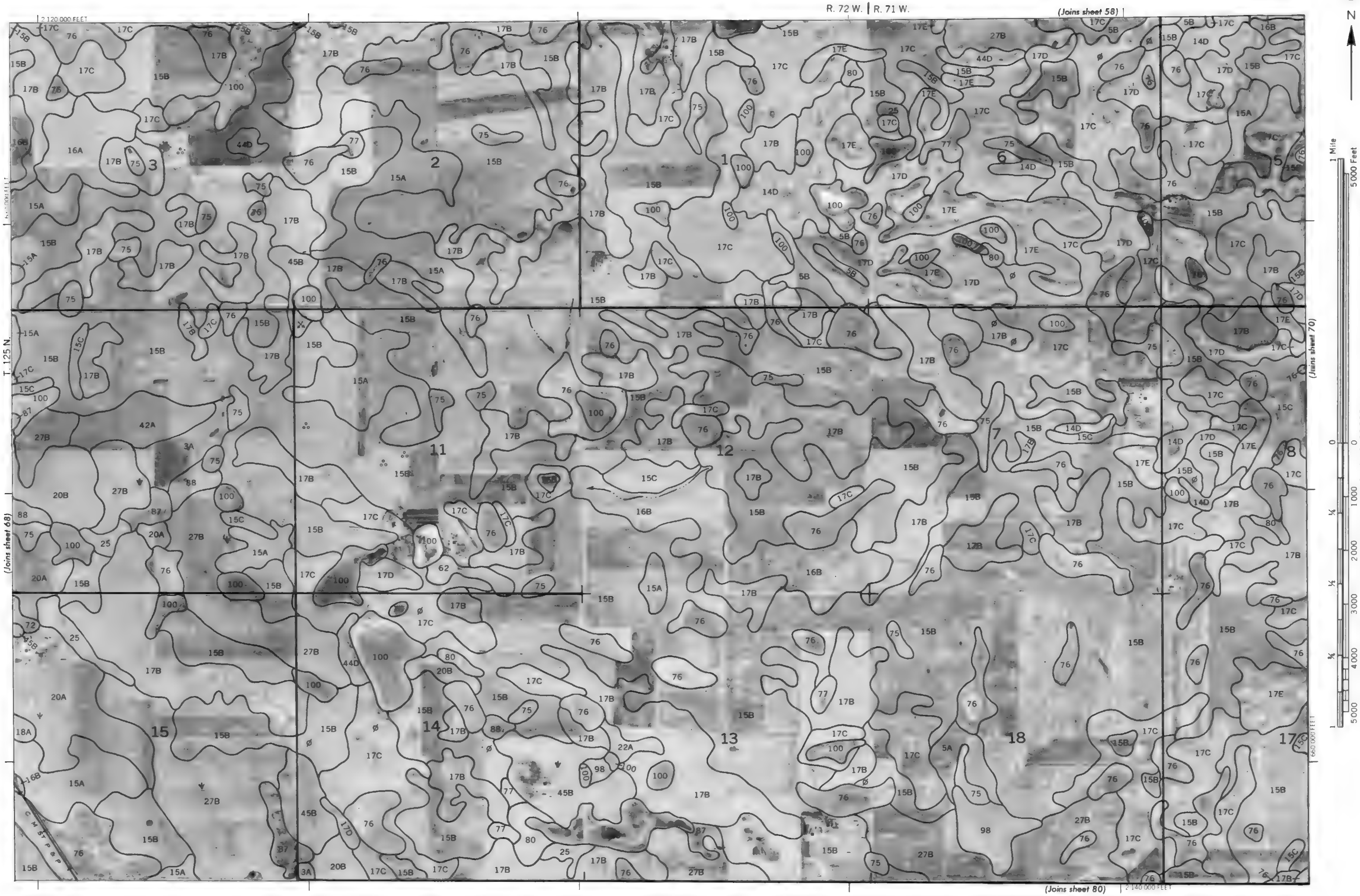
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 65



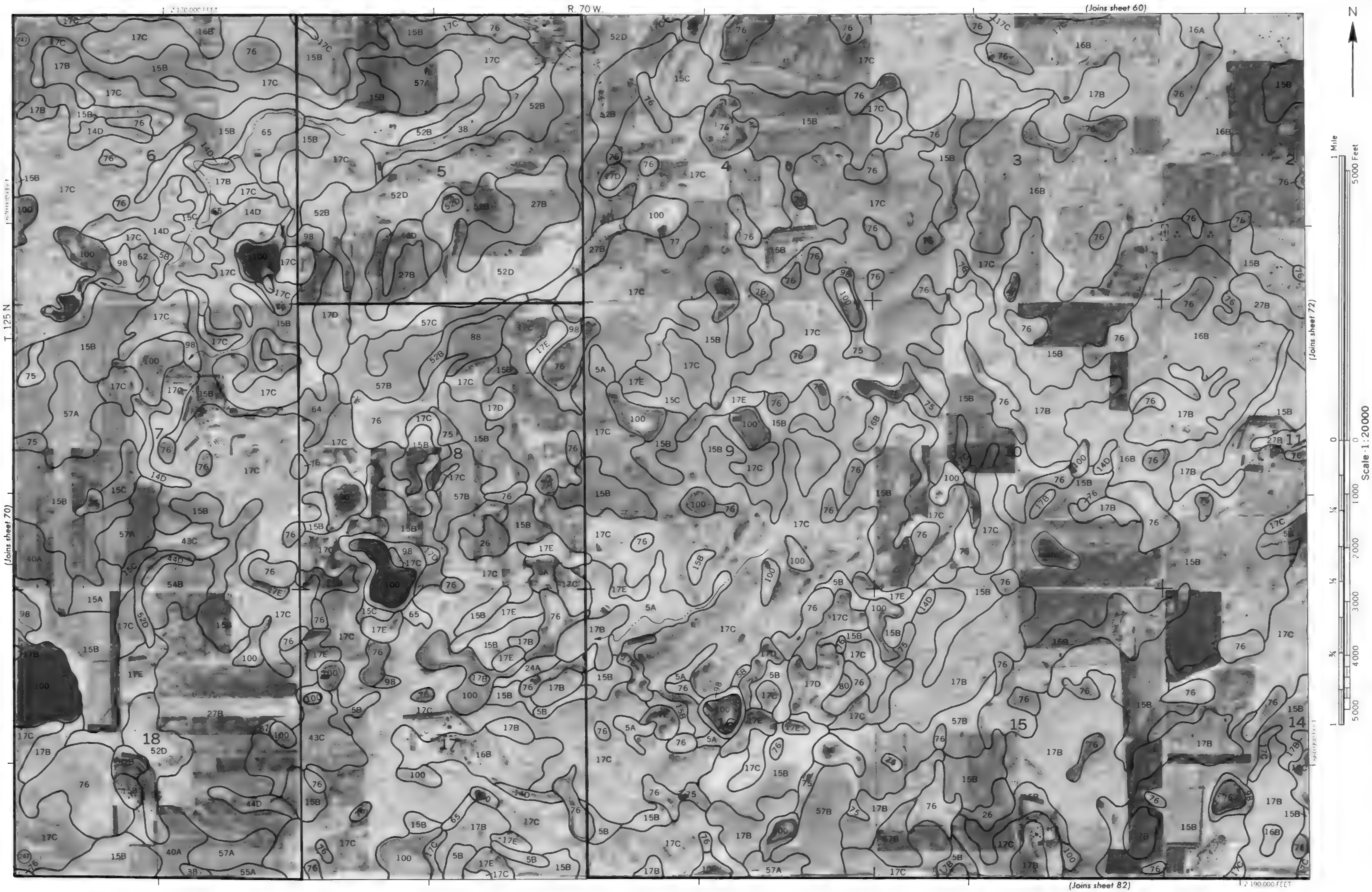

N
(Joins sheet 55)
R. 66 W.
2 330 000 FEET
690 000 FEET
T. 126 N.
(Joins sheet 65)
(Joins sheet 77)
2 310 000 FEET
680 000 FEET
1 Mile
5000 Feet
Scale 1:20000
22
23
24
25
26
27
34
35
36
Willow
Creek
BROWN
COUNTY

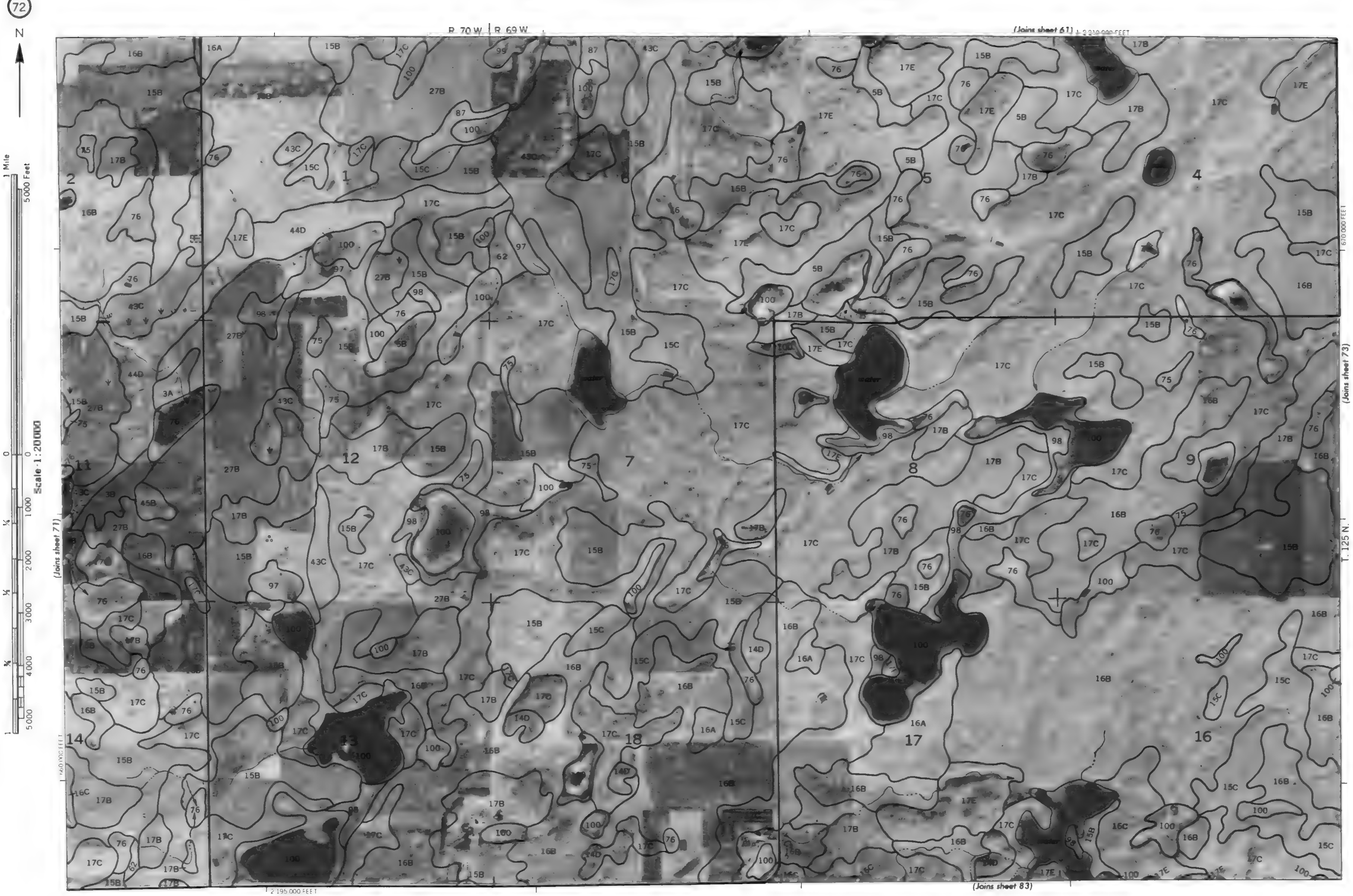

R 73 W
(Joins sheet 56)
T 125 N.
CAMPBELL COUNTY
(Joins sheet 68)
(Joins sheet 78)
water
water
N
1 Mile
5000 Feet
Scale 1:20000


(Joins sheet 57)
R. 73 W. | R. 72 W.
(Joins sheet 67)
(Joins sheet 69)
(Joins sheet 79)
T. 125 N.
N
Scale 1:20000
1 Mile
5000 Feet
CHICAGO
MILWAUKEE
ST. PAUL
AND
PACIFIC

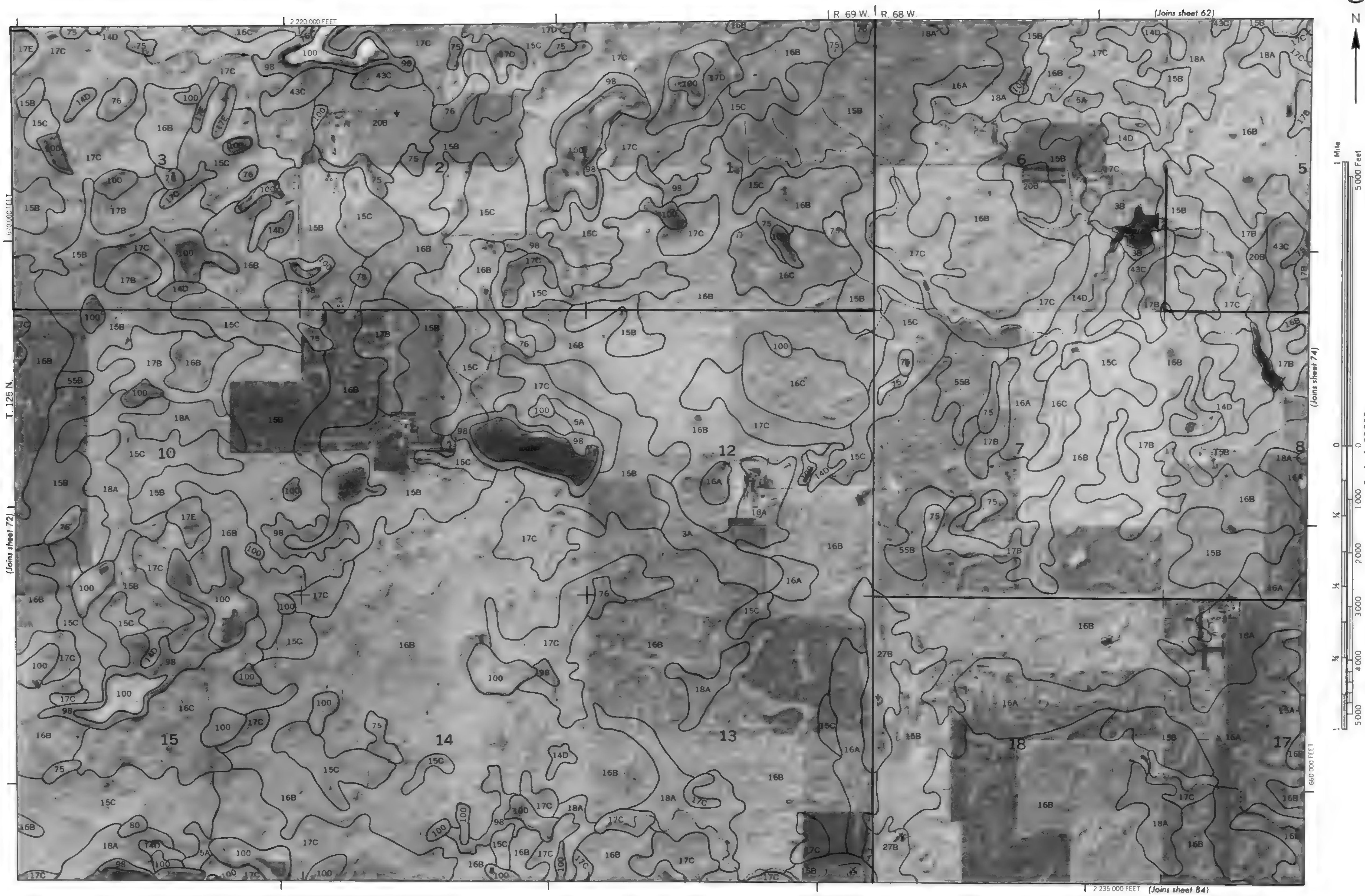

69
N
R. 72 W. | R. 71 W.
(Joins sheet 58)
(Joins sheet 68)
(Joins sheet 70)
(Joins sheet 80)
T. 125 N.
2 120 000 FEET
2 140 000 FEET
660 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾

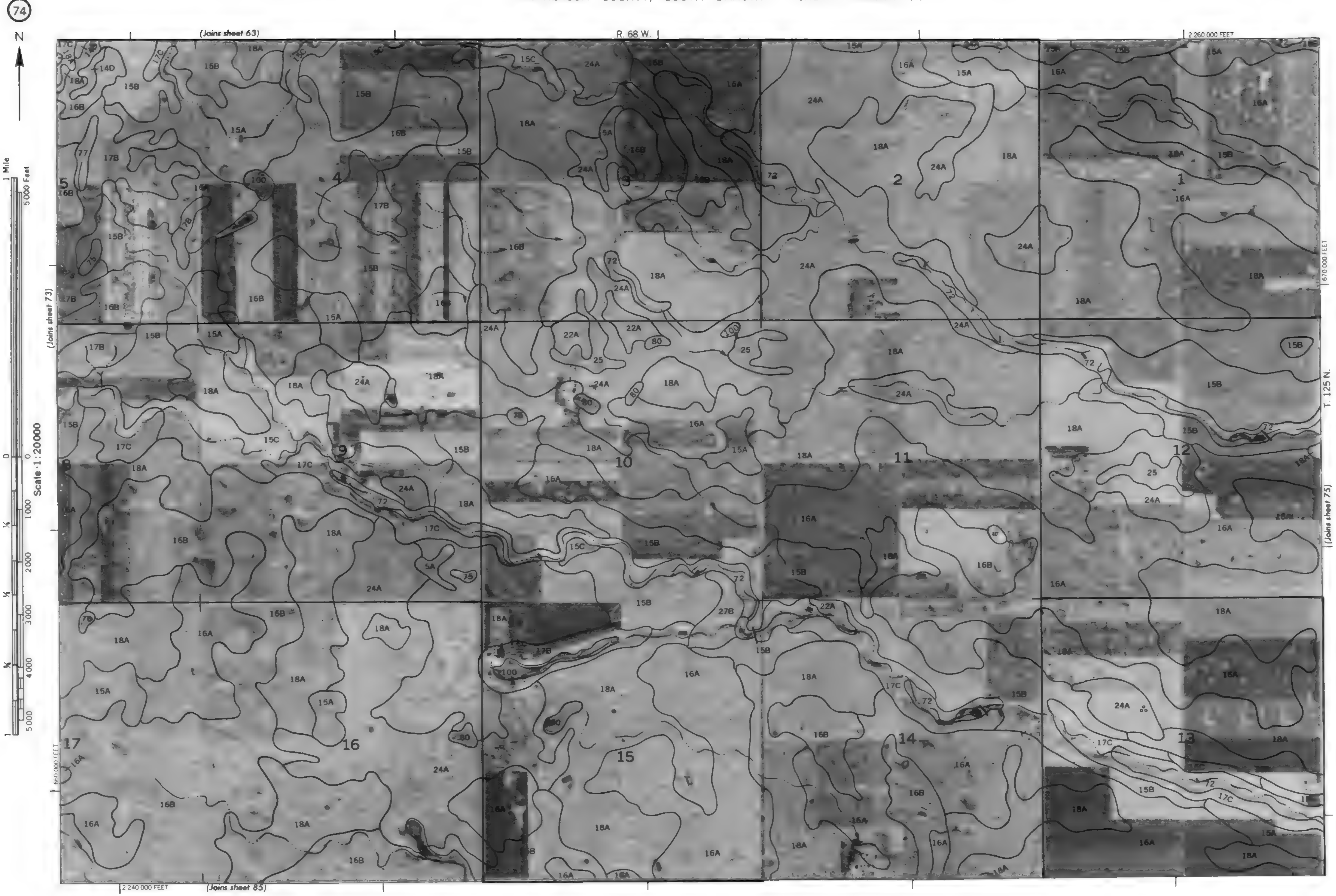

70
N
(Joins sheet 59)
R. 71 W.
2 165 000 FEET
(Joins sheet 69)
(Joins sheet 71)
T. 125 N.
(Joins sheet 81)
2 145 000 FEET
660 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000

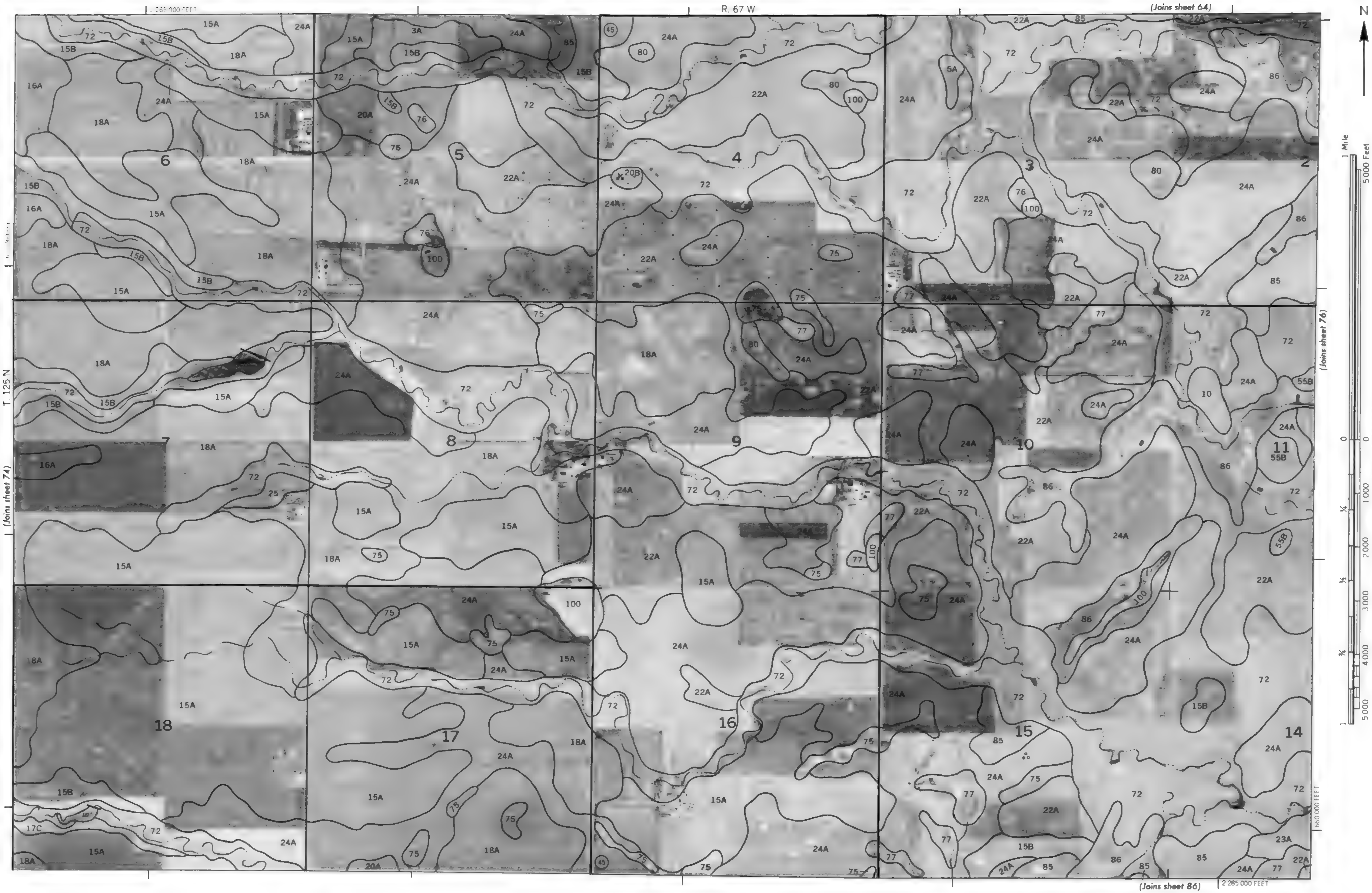

71
N
R. 70 W.
(Joins sheet 60)
T. 125 N.
(Joins sheet 70)
(Joins sheet 72)
(Joins sheet 82)
2 190 000 FEET
1 Mile
5000 Feet
Scale 1:20000
1
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18

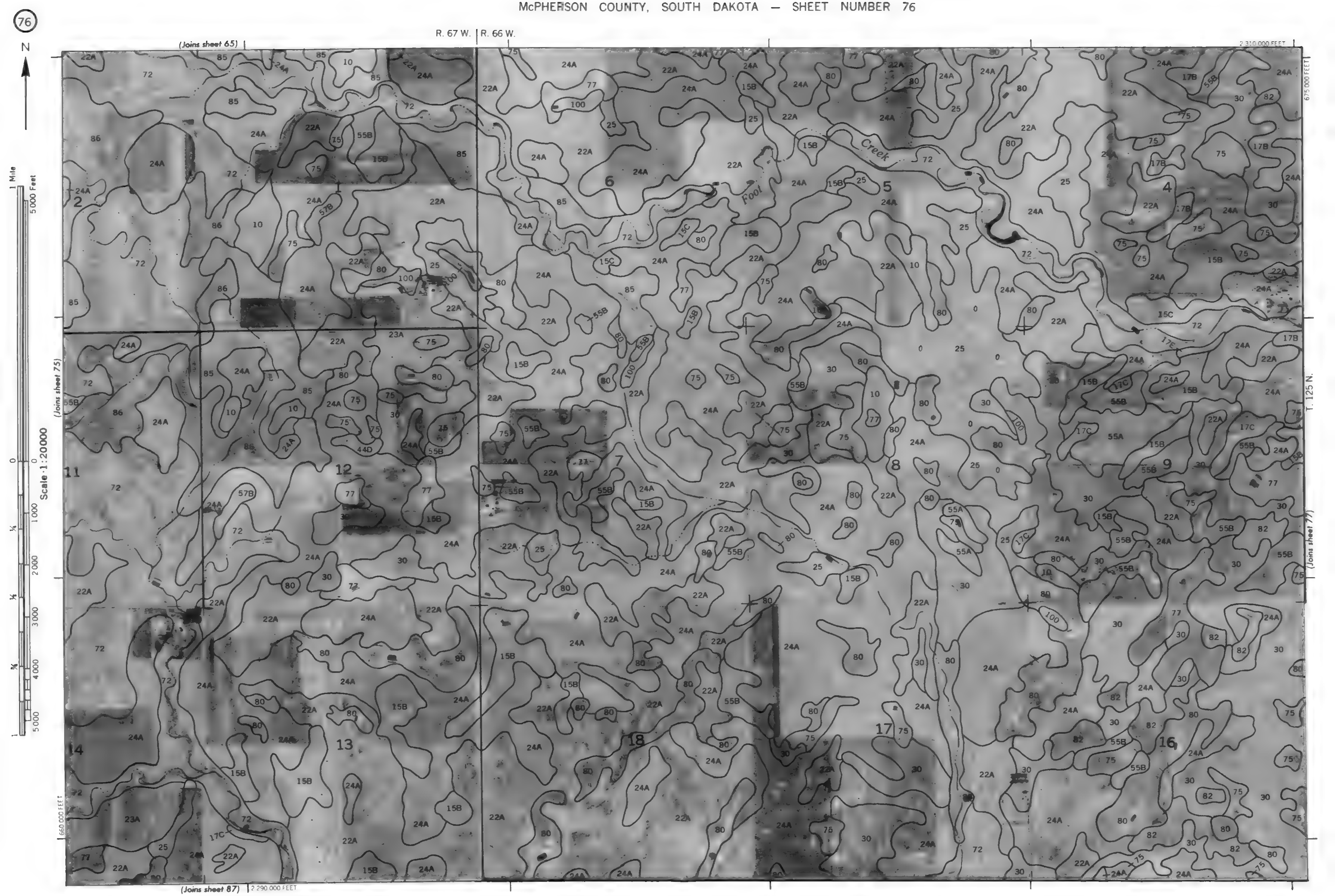

N
R. 70 W. | R. 69 W.
(Joins sheet 61)
(Joins sheet 73)
(Joins sheet 83)
(Joins sheet 71)
T. 125 N.
Scale 1:20000
1 Mile
5000 Feet
2 195 000 FEET
670 000 FEET
water

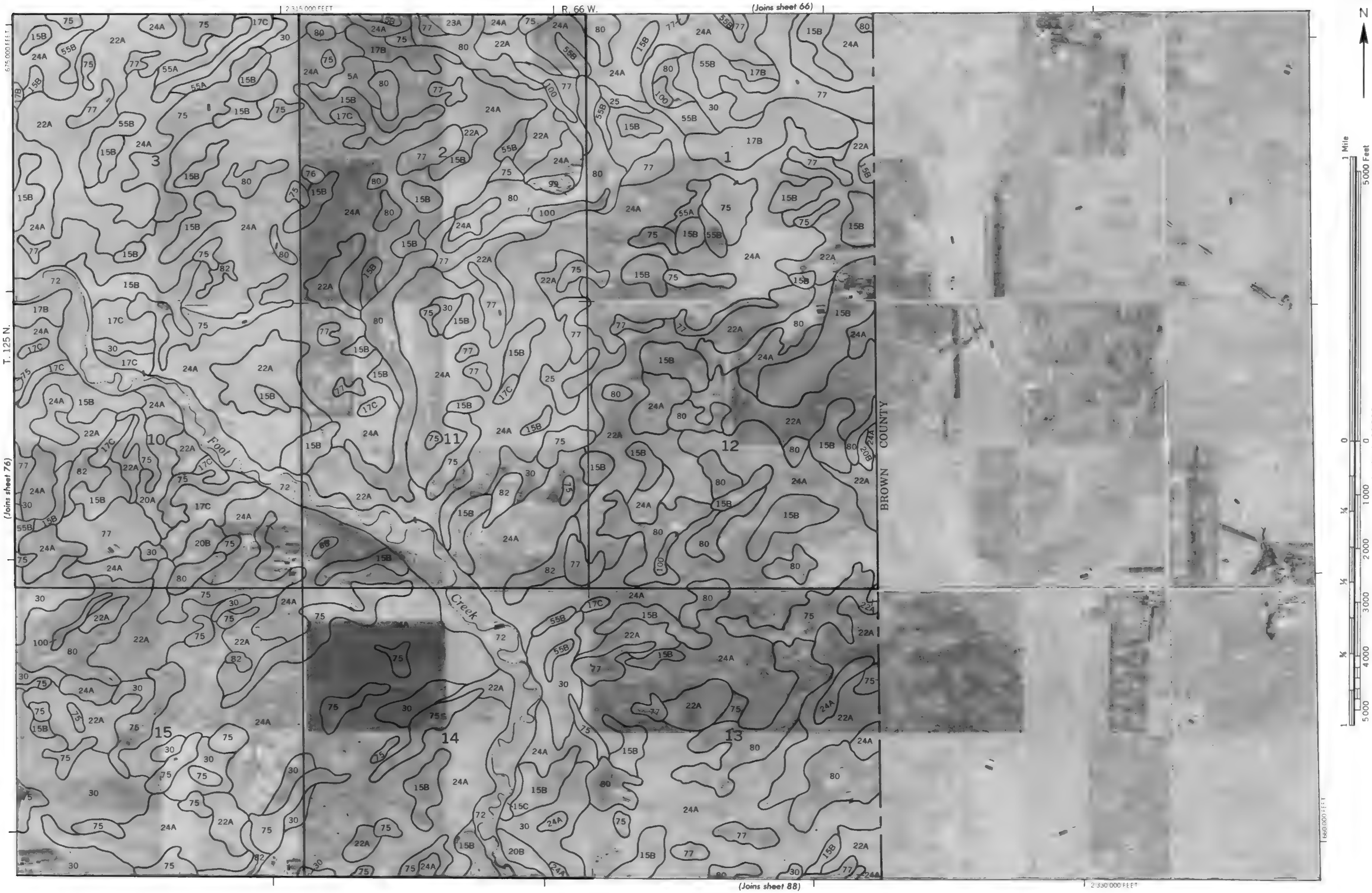
McPHERSON COUNTY, SOUTH DAKOTA — SHEET NUMBER 73

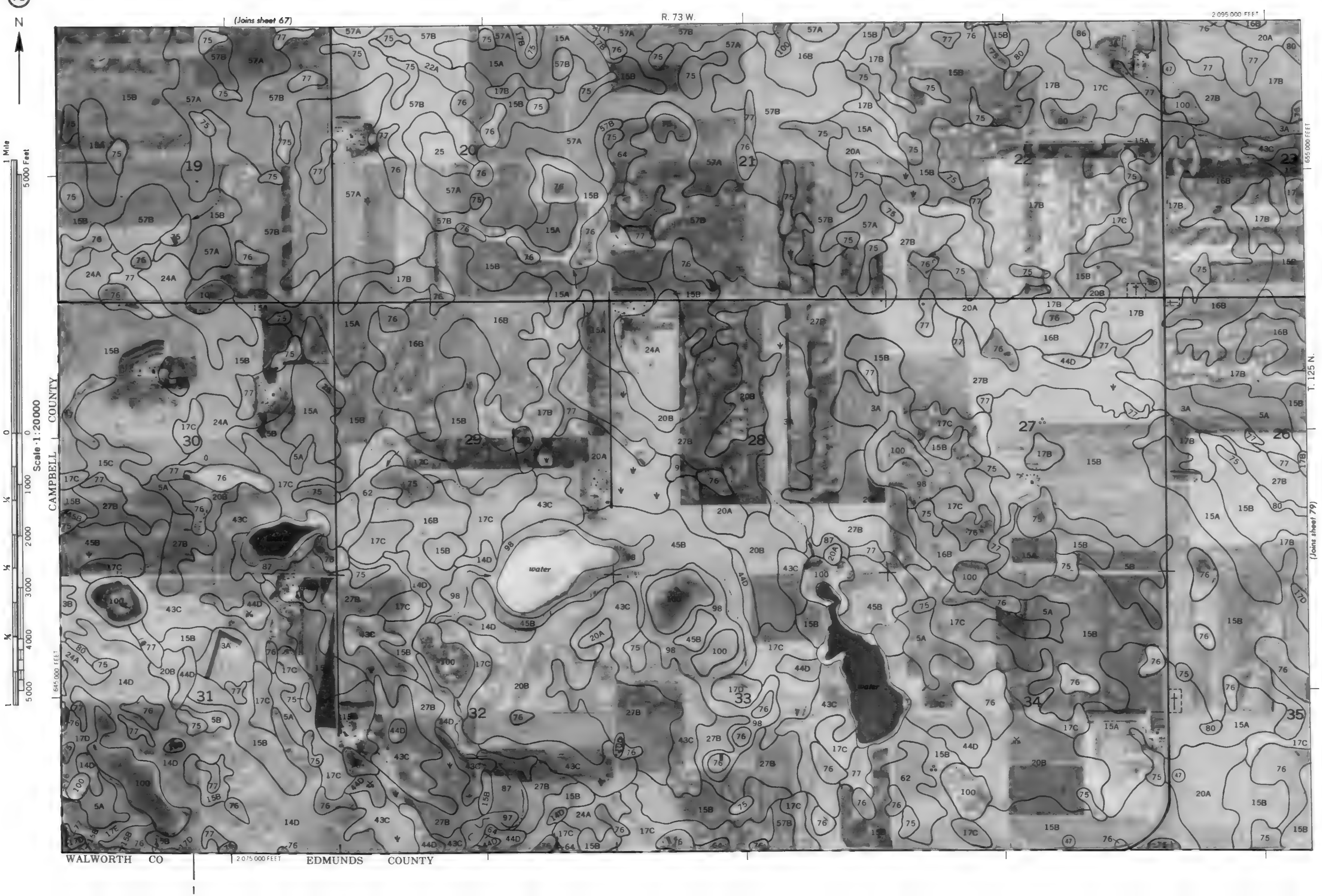


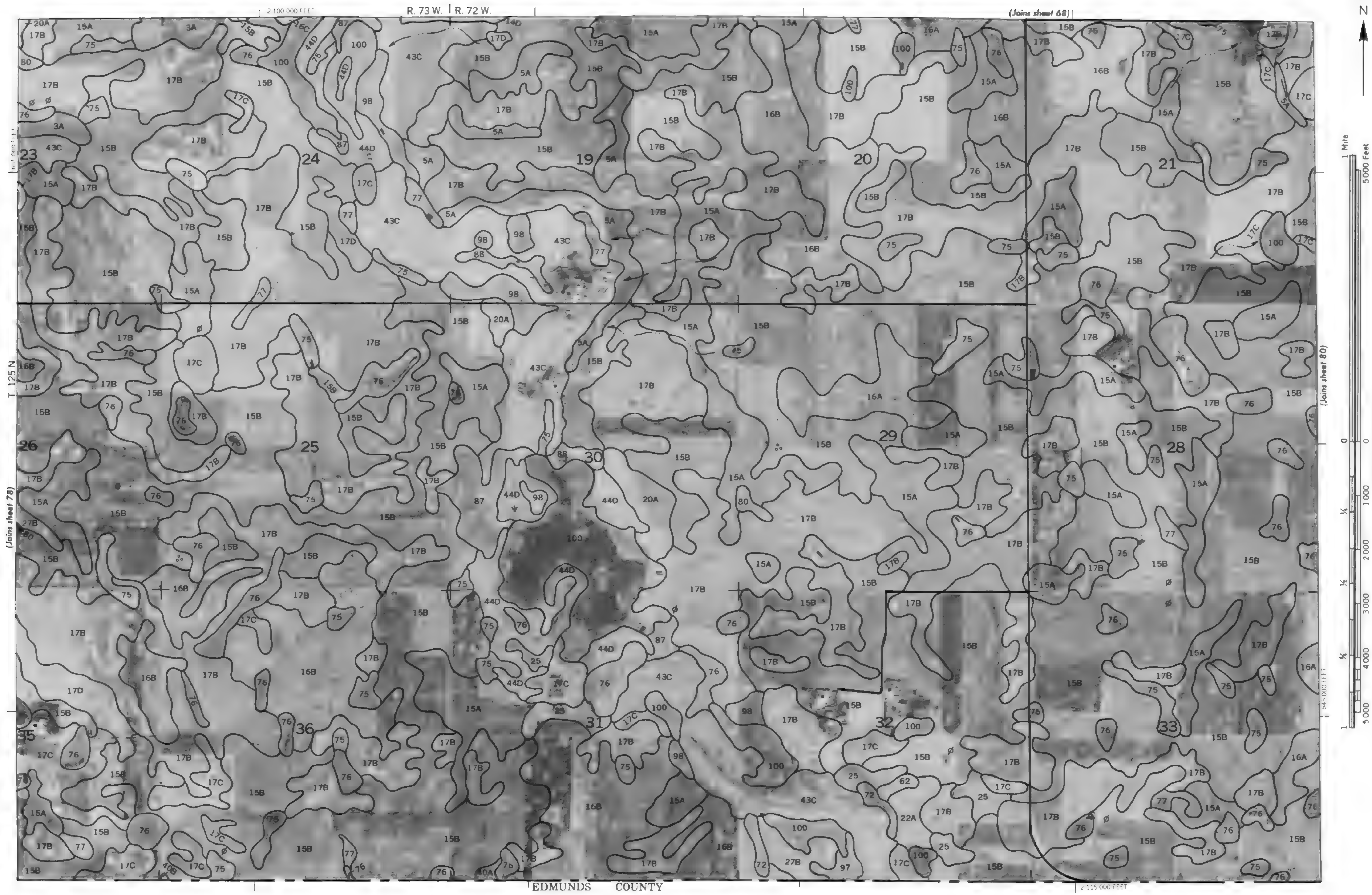

74
N
(Joins sheet 63)
R. 68 W.
2 260 000 FEET
(Joins sheet 73)
(Joins sheet 75)
T. 125 N.
670 000 FEET
660 000 FEET
2 240 000 FEET
(Joins sheet 85)
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
14D
15A
15B
15C
16A
16B
17B
17C
18A
22A
24A
25
27B
5A
72
75
77
78
80
100


2 265 000 FEET
R. 67 W
(Joins sheet 64)
N
T. 125 N
(Joins sheet 74)
(Joins sheet 76)
(Joins sheet 86)
2 285 000 FEET
560 000 FEET
1 Mile
5000 Feet
Scale 1:20000
6
5
4
3
2
7
8
9
10
11
18
17
16
15
14

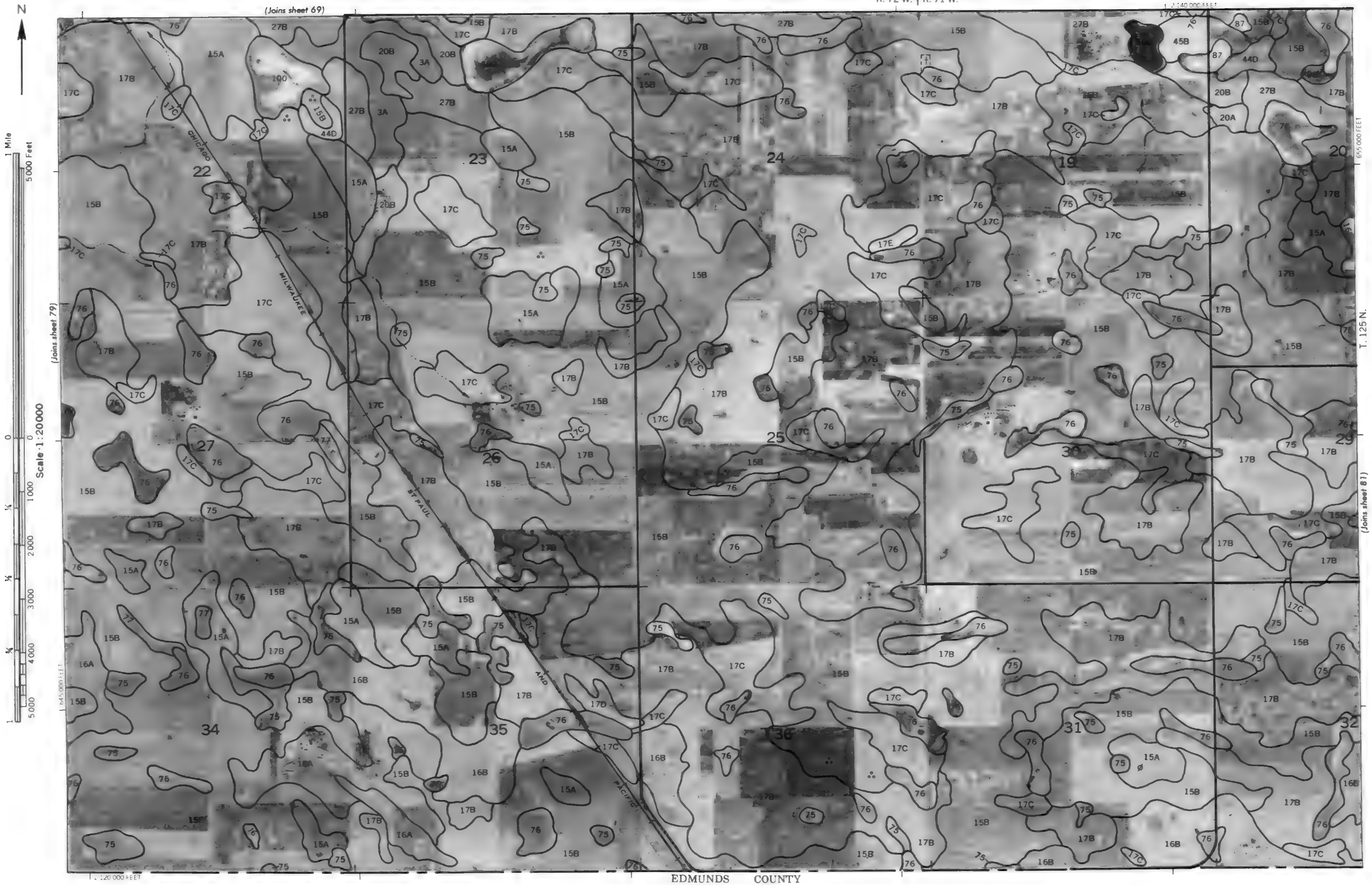

76
N
R. 67 W.
R. 66 W.
(Joins sheet 65)
(Joins sheet 75)
(Joins sheet 77)
(Joins sheet 87)
2 310 000 FEET
2 290 000 FEET
675 000 FEET
660 000 FEET
T. 125 N.
1 Mile
5000 Feet
Scale 1:20000
Fool Creek

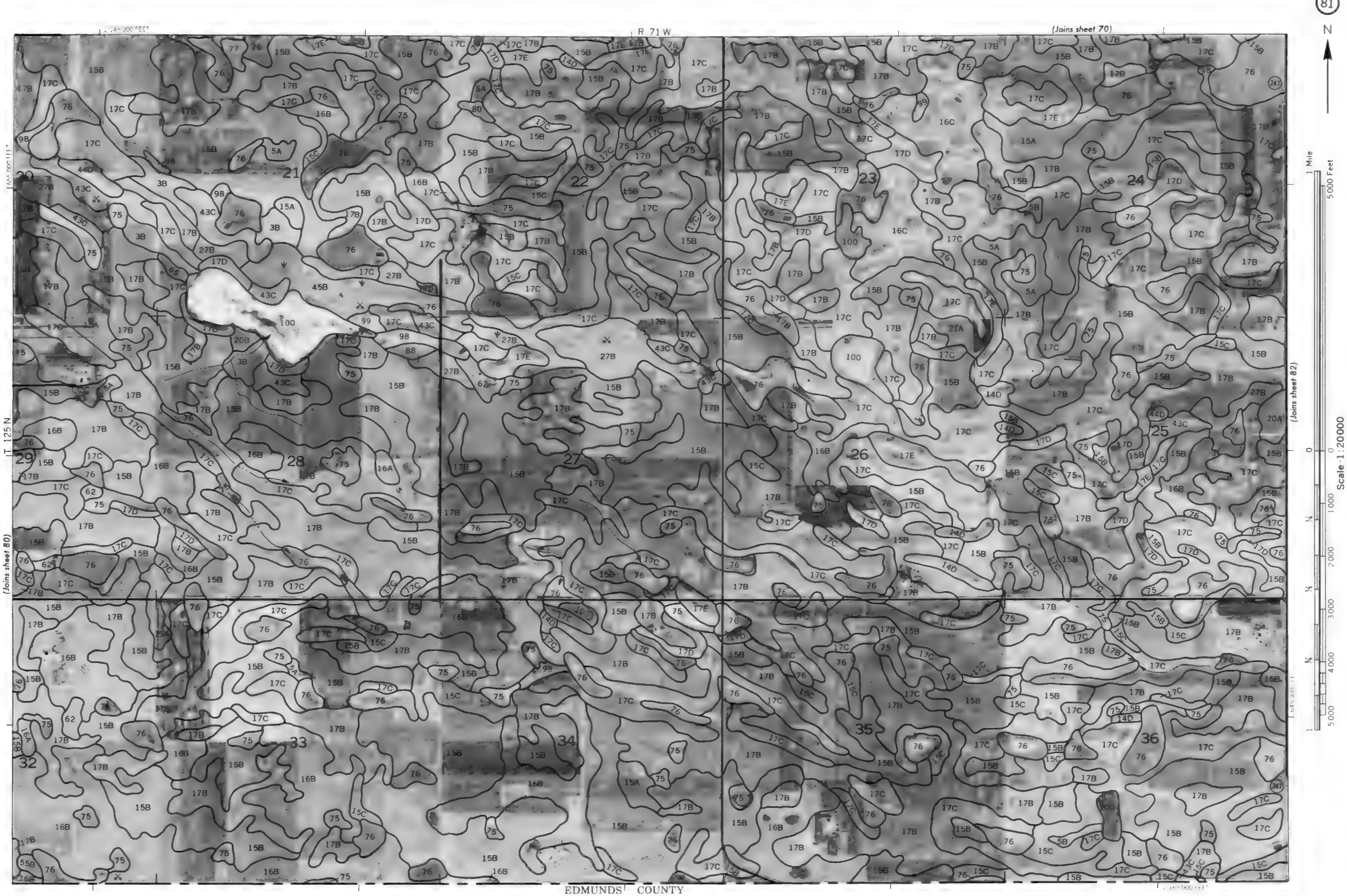

77
N
R. 66 W.
(Joins sheet 66)
T. 125 N.
(Joins sheet 76)
(Joins sheet 88)
BROWN COUNTY
Fool Creek
1 Mile
5000 Feet
Scale 1:20000
2 315 000 FEET
2 330 000 FEET

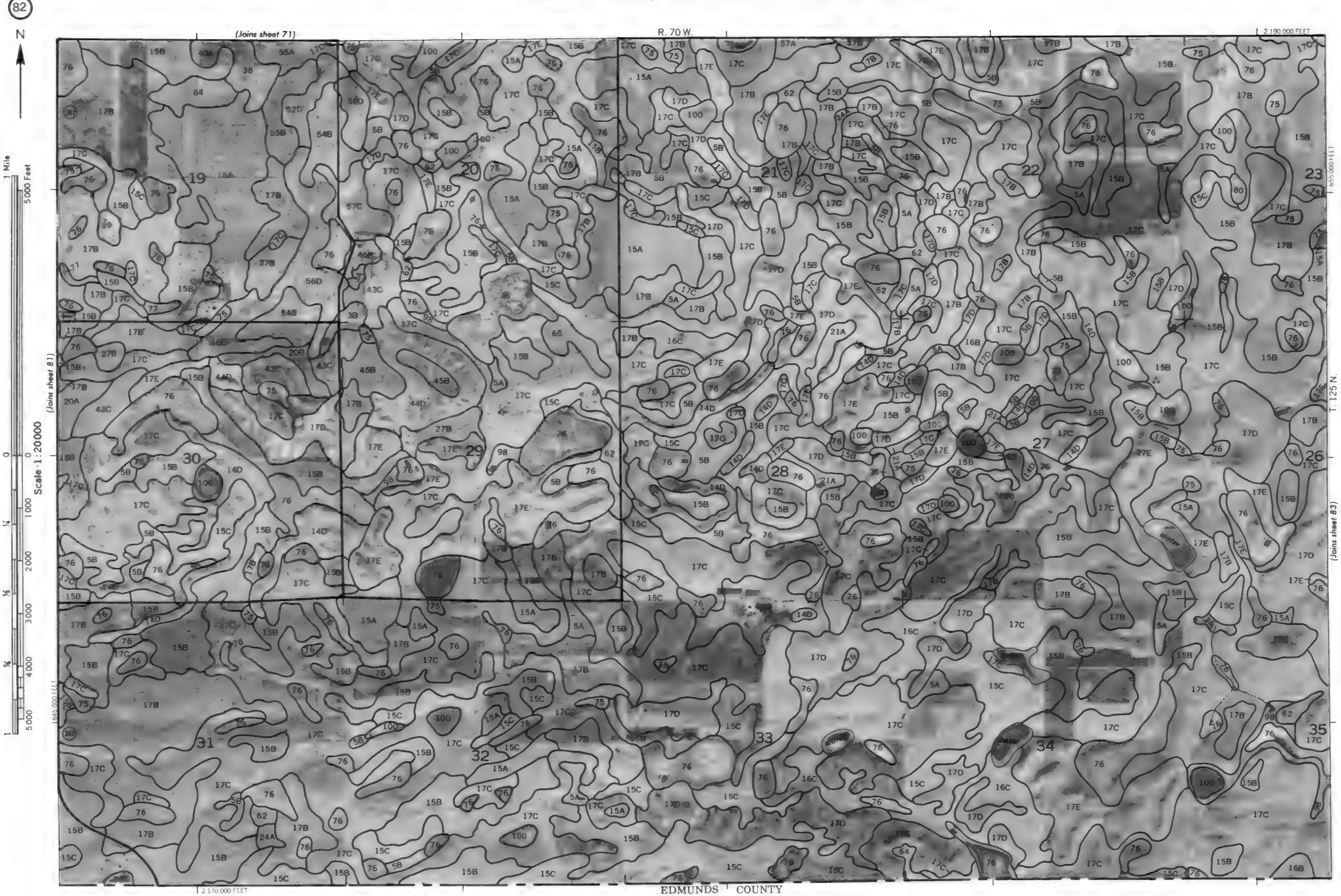

N
(Joins sheet 67)
R. 73 W.
2 095 000 FEET
655 000 FEET
T. 125 N.
(Joins sheet 79)
CAMPBELL COUNTY
WALWORTH CO
EDMUNDS COUNTY
2 075 000 FEET
645 000 FEET
Scale 1:20000
1 Mile
5000 Feet
water
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

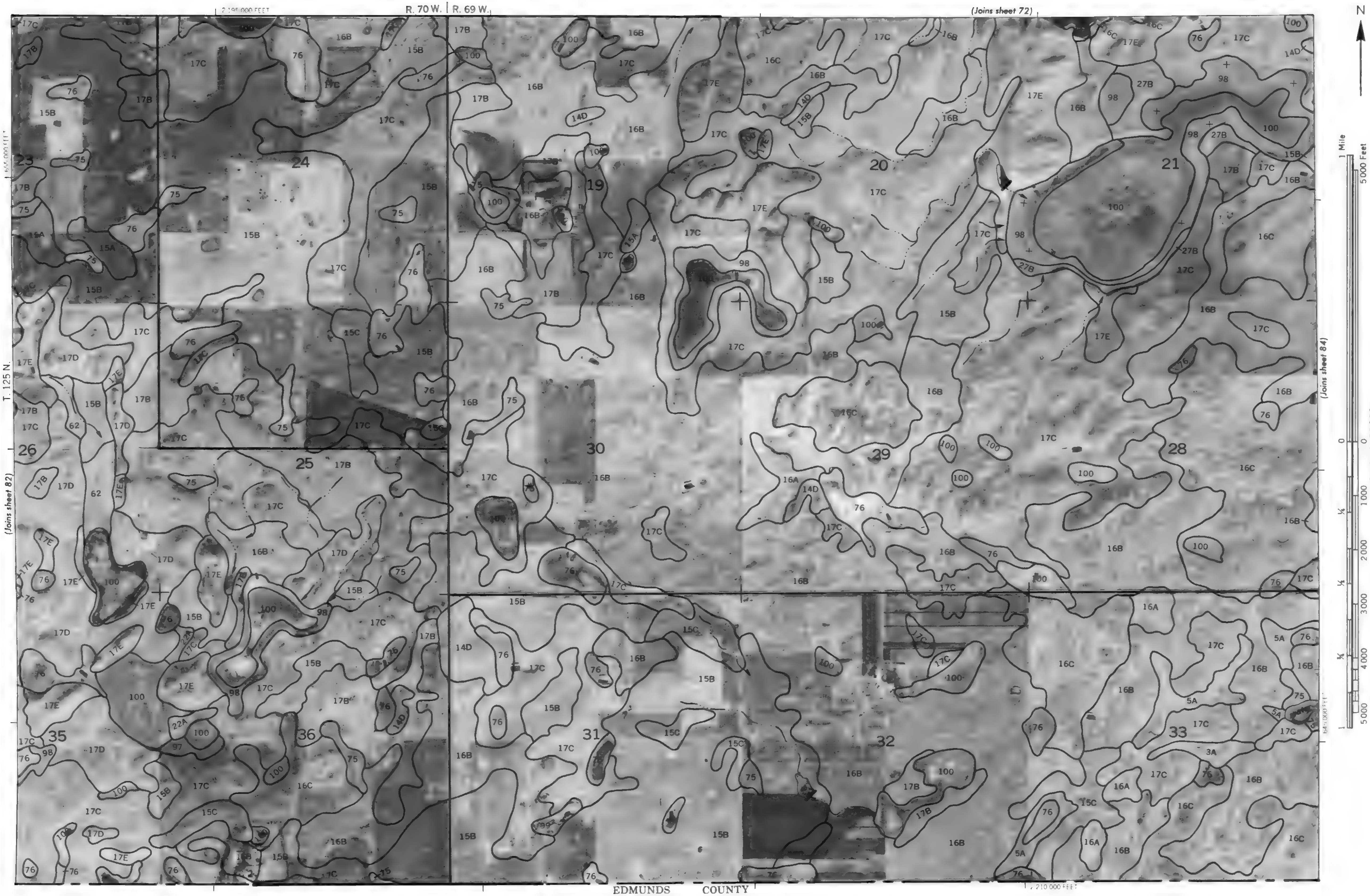


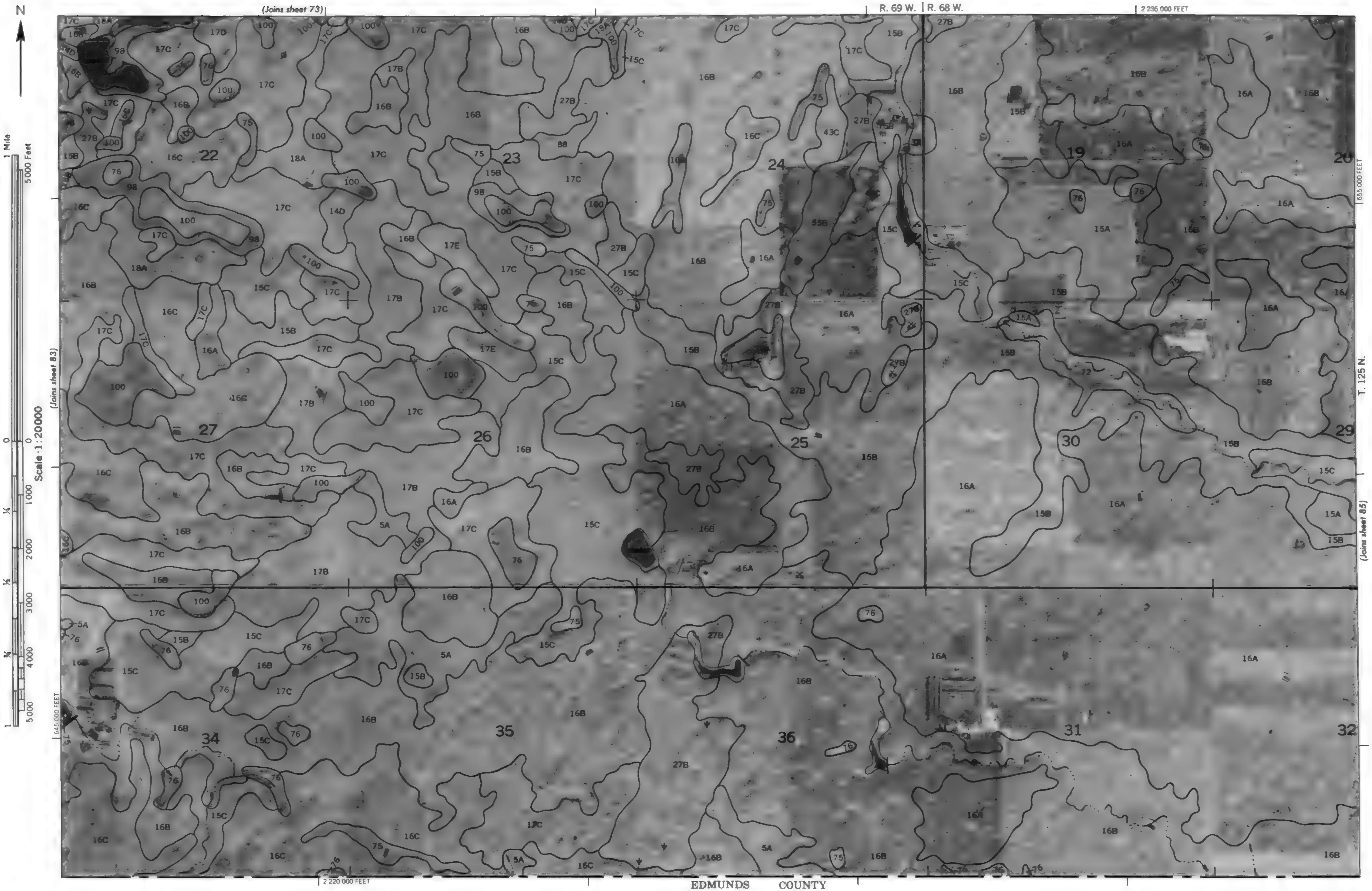
R. 73 W. | R. 72 W.
2 100 000 FEET
(Joins sheet 68)
(Joins sheet 78)
(Joins sheet 80)
T. 125 N.
EDMUNDS COUNTY
2 115 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

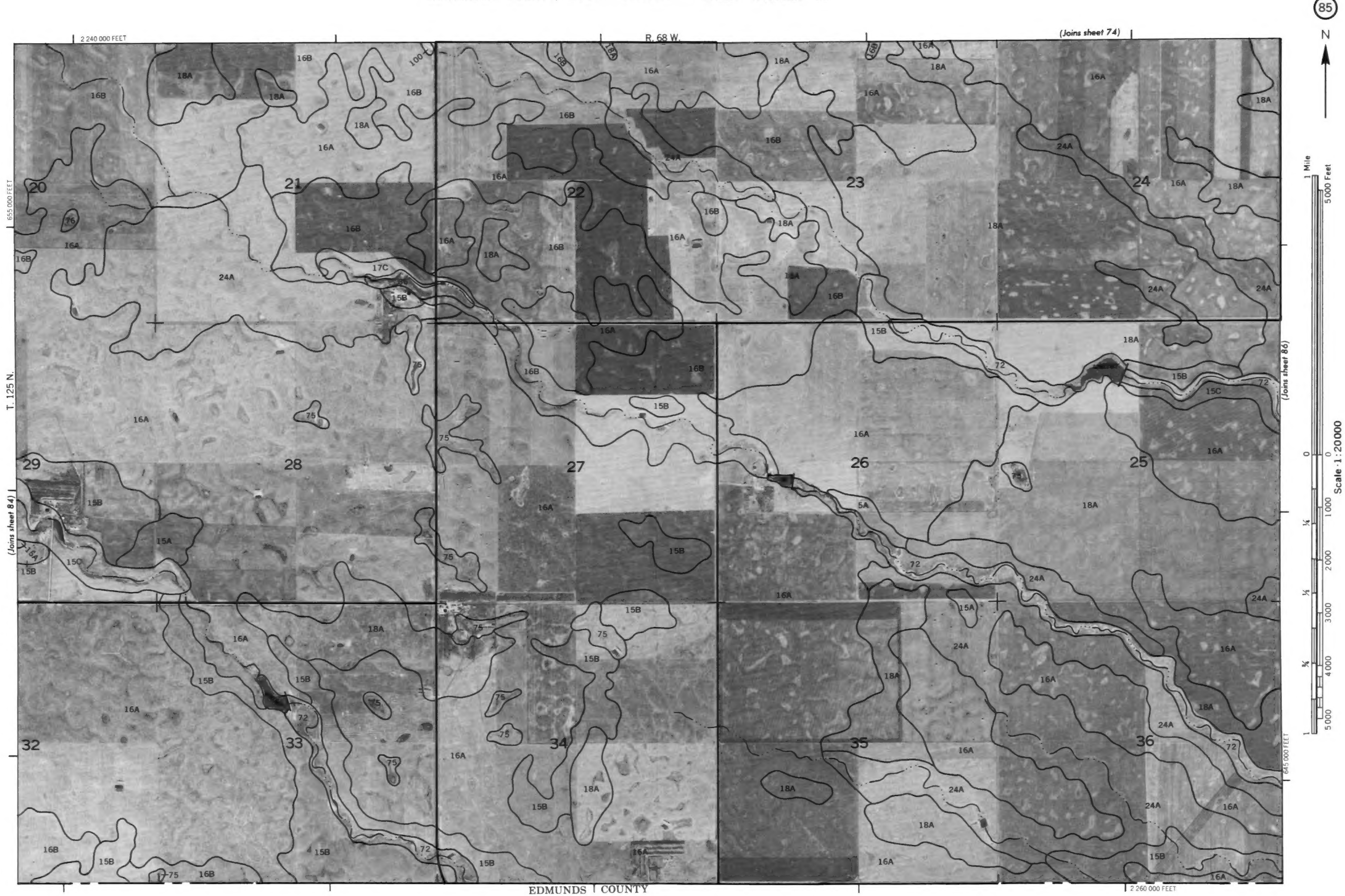

80
N
(Joins sheet 69)
R. 72 W.
R. 71 W.
2 140 000 FEET
655 000 FEET
T. 125 N.
(Joins sheet 79)
(Joins sheet 81)
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
2 120 000 FEET
EDMUNDS COUNTY

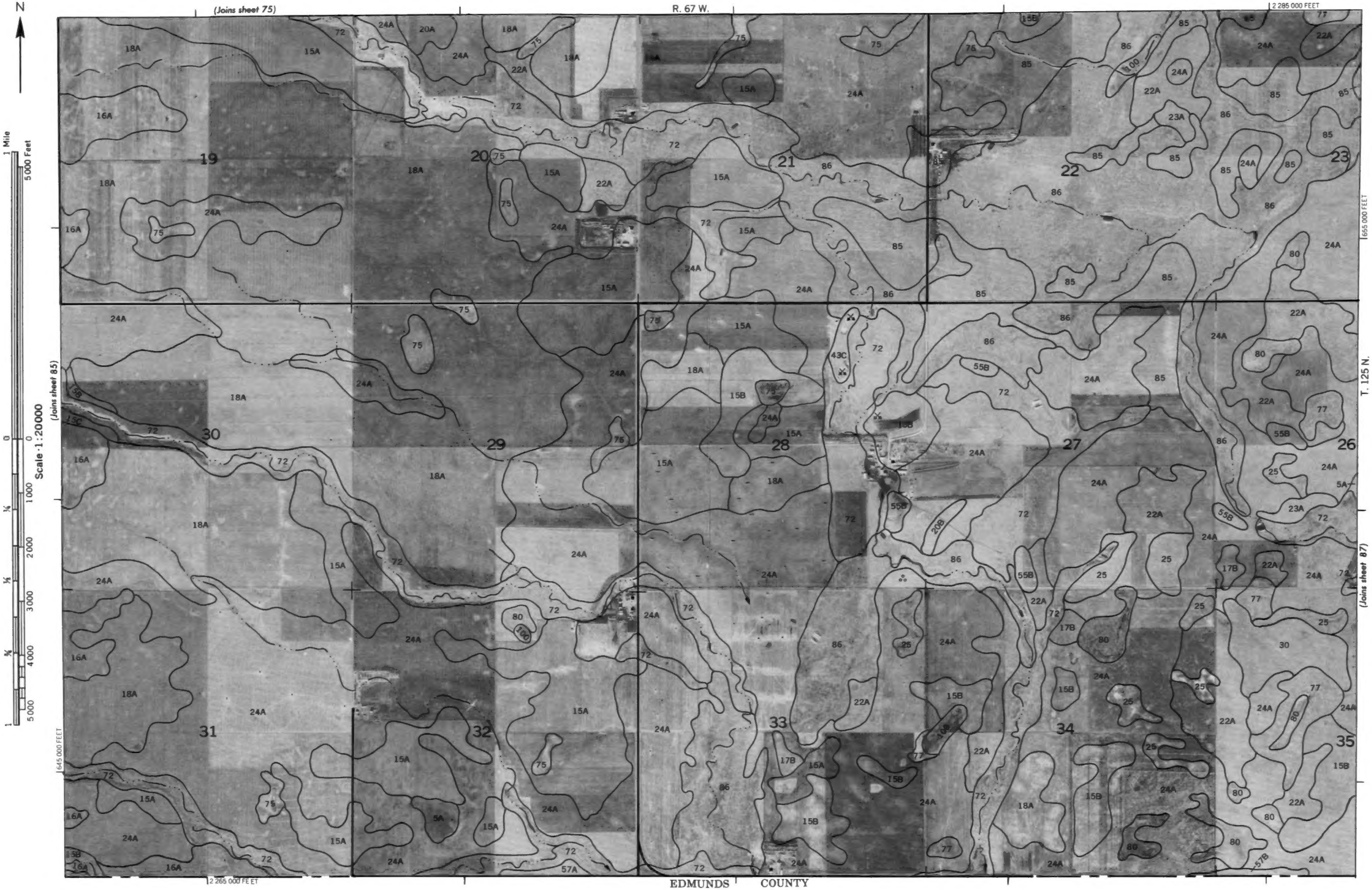

81
N
R. 71 W.
(Joins sheet 70)
(Joins sheet 82)
(Joins sheet 80)
T. 125 N.
EDMUNDS COUNTY
1 Mile
5000 Feet
Scale 1:20000
21
22
23
24
25
26
27
28
29
32
33
34
35
36

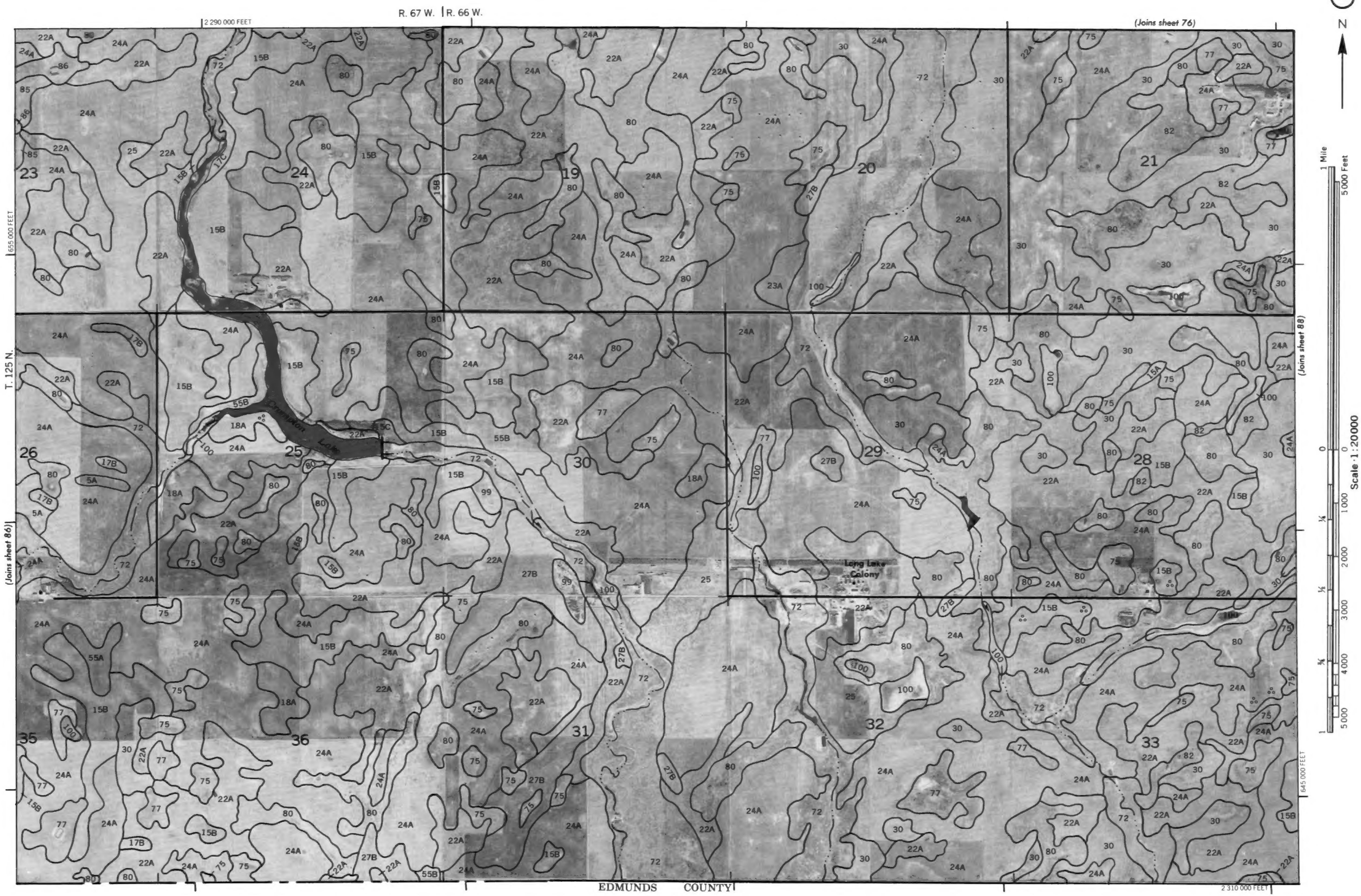

82
N
(Joins sheet 71)
R. 70 W.
2 190 000 FEET
655 000 FEET
T. 125 N.
(Joins sheet 81)
(Joins sheet 83)
1 Mile
5000 Feet
Scale 1:20000
645 000 FEET
2 170 000 FEET
EDMUNDS COUNTY
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

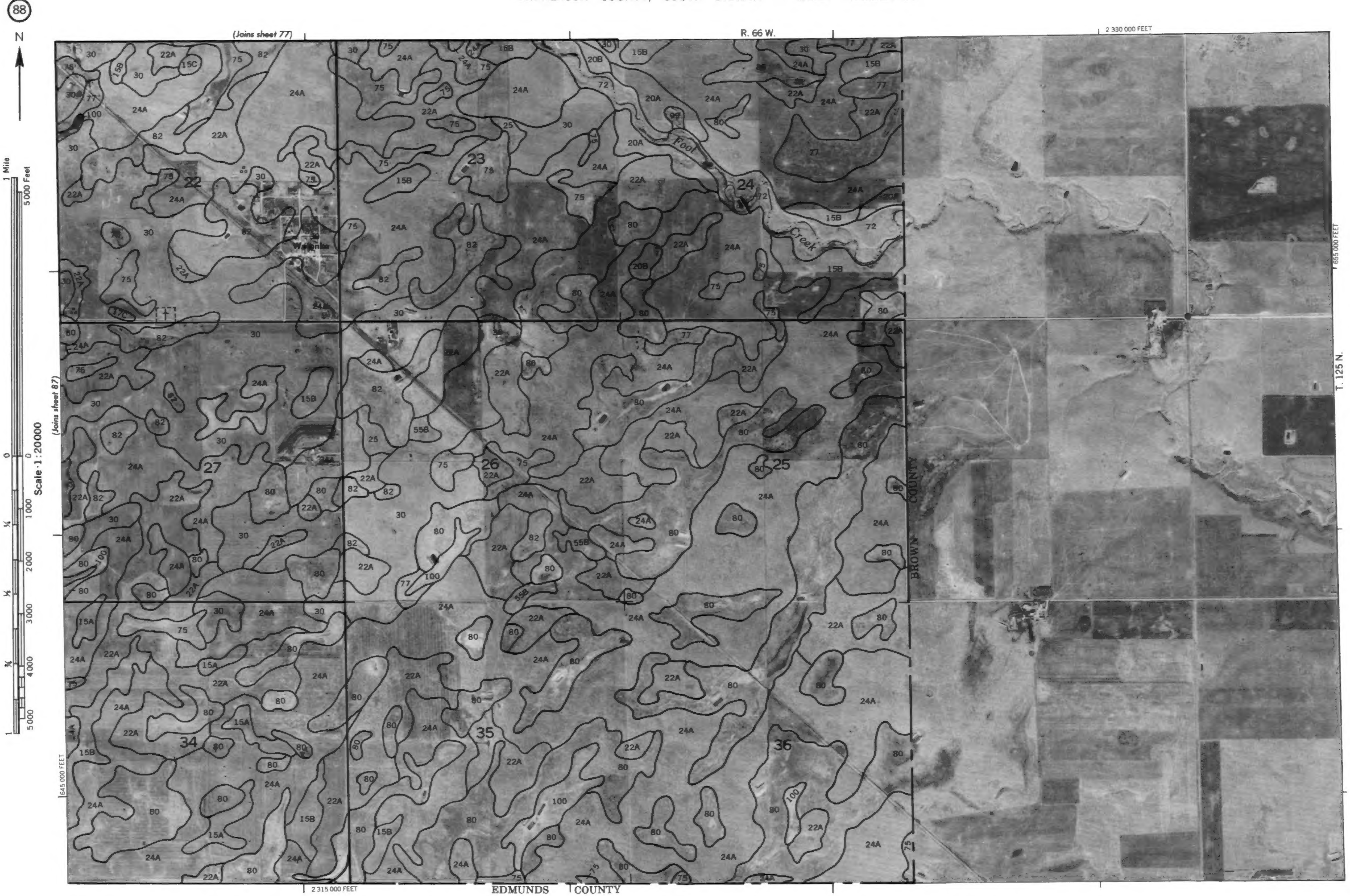

R. 70 W.
R. 69 W.
(Joins sheet 72)
(Joins sheet 84)
(Joins sheet 82)
T. 125 N.
N
1 Mile
5000 Feet
Scale 1:20 000
EDMUNDS COUNTY
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36


N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 73)
R. 69 W.
R. 68 W.
2 236 000 FEET
655 000 FEET
T. 125 N.
(Joins sheet 83)
(Joins sheet 85)
645 000 FEET
2 220 000 FEET
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
EDMUNDS COUNTY


85
N
(Joins sheet 74)
R. 68 W.
2 240 000 FEET
655 000 FEET
T. 125 N.
(Joins sheet 84)
(Joins sheet 86)
645 000 FEET
2 260 000 FEET
EDMUNDS COUNTY
20
21
22
23
24
29
28
27
26
25
32
33
34
35
36
1 Mile
5000 Feet
Scale 1:20000


N
(Joins sheet 75)
R. 67 W.
2 285 000 FEET
655 000 FEET
T. 125 N.
(Joins sheet 87)
(Joins sheet 85)
645 000 FEET
2 265 000 FEET
EDMUNDS COUNTY
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35


87
N
R. 67 W.
R. 66 W.
2 290 000 FEET
(Joins sheet 76)
(Joins sheet 88)
(Joins sheet 86)
T. 125 N.
655 000 FEET
645 000 FEET
2 310 000 FEET
Crompton Lake
Long Lake Colony
EDMUNDS COUNTY
1 Mile
5000 Feet
Scale 1:20000


88
N
(Joins sheet 77)
R. 66 W.
2 330 000 FEET
655 000 FEET
T. 125 N.
(Joins sheet 87)
645 000 FEET
2 315 000 FEET
EDMUNDS COUNTY
BROWN COUNTY
Foot Creek
Scale 1:20000
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
22
23
24
25
26
27
34
35
36